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ABSTRACT

This study seeks to obtain baseline information about the relationships among medical technology education, certification, and job performance. The sample was 1,861 technologists who filed for the July 1962 certification examination. Information concerned: (1) performance in preclinical and clinical study, and in the certification examination, (2) schools of medical technology, (3) characteristics of medical technologists and laboratory supervisors, and (4) job performance ratings. Some general findings were: (1) There was no statistically significant difference between job performance ratings of technologists who passed and those who failed the certification examination, and (2) More of those who passed the certification examination had received satisfactory preclinical grades and were rated "excellent" or "good" in clinical study performance than those who failed. General conclusions were: (1) Curriculums leading to the Bachelor of Science degree in medical technology constitute more adequate preparation for the profession than other curriculums, and (2) Clinical education programs which employ certified technologists with college degrees and which enroll more than eight students appear to be more successful. Questionnaires are appended. (JK)

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National Correlations
IN
Medical Technology Education

A REPORT OF A STUDY OF MEDICAL TECHNOLOGISTS

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NATIONAL CORRELATIONS
in
MEDICAL TECHNOLOGY EDUCATION

A Report of a Study of Medical Technologists

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INTRODUCTION

Do current education programs in medical technology adequately prepare students to meet present and future demands in the profession? Do certification procedures adequately test whether these medical technologists will or will not perform well in the laboratory? Questions such as these prompted the National Council on Medical Technology Education, in 1964, to obtain baseline information about the relationships between medical technology education, certification and job performance.

The Council was founded in July 1964 to implement, nationally, the recommendations of the Alabama Project prepared two years previously. That project made significant contributions to medical technology education in Alabama through developing teaching methods, faculty, and related resource material; strengthening affiliations between schools of medical technology and Alabama universities; enlarging student recruitment efforts; and scheduling program reviews. The success of the Alabama Project encouraged national application of its achievements to the improvement of medical technology education elsewhere.1/

When the Council met for this purpose in October 1964, they immediately recognized a need for additional information prior to broad implementation of the Alabama Project recommendations. Accordingly, they embarked on a program of inquiry designed to elicit general statements of adequacy regarding medical technology education and certification, and to weigh these factors against general statements about job performance of technologists who have completed this preparation. This study received added impetus from recent reports indicating that the percentage of error in medical laboratory tests throughout the nation is larger than should be expected.2/

The medical technologists selected for this study constitute a sample of the 1,861 technologists who filed for the July 1962 certification examination administered by the Board of Registry of Medical Technologists of the American Society of Clinical Pathologists. Questionnaires completed and returned by the technologists in the sample supplied information about their experiences in clinical work situations. Data concerning their educational preparation and certification records were obtained from the office of the Registry of Medical Technologists (ASCP). Information concerning the clinical study programs (schools of medical technology) was provided by the office of the Board of Schools of Medical Technology (ASCP). Finally, job performance evaluations for technologists included in the sample were obtained from their immediate supervisors at the time the study was conducted. These laboratory supervisors also submitted information relating to their own education and experience.

Information collected from these sources is tabulated and reported in detail in the section of this report entitled "Findings". The methodology employed to evaluate the data and validate results is described in Appendix A. Copies of the questionnaires used in assembling the basic data appear in Appendices C and D.

1/ A more detailed account of the Alabama Project and the history of the National Council on Medical Technology Education is available in Appendix B of this report.

2/ Statement of Assistant Surgeon General David J. Sencer, Chief of the National Communicable Disease Center, U. S. Public Health Service, before the Subcommittee on Antitrust and Monopoly, Committee of the Judiciary, United States Senate. Hearings on S260 ("Medical Restraint of Trade"), 90th Congress, 1st Session; Report of Proceedings, Vol. 7, p. 572.

The Council wishes to express its gratitude to Dr. Wellington B. Stewart, Chairman of the Board of Registry of Medical Technologists (ASCP), and Mrs. Maryland Y. Pennell, Chief of the Manpower Statistical Branch of the National Center for Health Statistics (U.S. Public Health Service) for invaluable assistance in sample selection and statistical detail; to the staff of the Yalem Scientific Computer Center, St. Louis University, St. Louis, Missouri for assistance in computing the findings; and to the medical technologists and laboratory supervisors who made this study possible.

CONCLUSIONS

I. In General

A. Primary Objectives: Relationship among Job Performance, Certification Examination Score, and Pre-Clinical and Clinical Study Grades.

This study finds certain relationships existing among the performance of medical technologists in their work and their performance in pre-clinical study, clinical study [1] and certification examination. The conclusion is based on the following determinations:

There is no statistically significant difference between job performance ratings by laboratory supervisors given technologists who passed the July 1962 certification examination and the technologists who failed the examination.

There is a tendency for more of those who passed the July 1962 certification examination to receive satisfactory grades (A, B, and C) and those who failed to receive unsatisfactory grades (D and F), particularly in inorganic chemistry, botany and/or biology, physics, histology and genetics.

Significantly more of those who passed the July 1962 certification examination were rated "excellent" or "good" in clinical study performance than those who failed.

B. Related Objectives: Medical Technology Education in Perspective

This study affords statistically significant evidence supporting the following conclusions:

Educational curricula leading to the degree of Bachelor of Science in Medical Technology constitute more adequate preparation for the profession than do other curricula.

Pre-clinical science courses for which grades appear to be most useful indicators of success or failure in the July 1962 certification examination are inorganic chemistry, botany and/or biology, physics, histology and genetics.

Clinical education programs appear to be more successful in fulfilling objectives when ASCP-certified medical technologists with college degrees comprise a major portion of their staffs, and when they are accredited for enrollment of more than eight students.

---

[1] "Pre-clinical study" refers to the academic study of physical, biological and medical sciences and elected liberal arts courses in a college or university accredited by an agency recognized for such purposes by the American Council on Education and the National Commission on Accrediting.

"Clinical study" refers to the study and practice of laboratory techniques in a medical laboratory accredited as a school of medical technology by the Council on Medical Education of the American Medical Association. Credit hours for clinical study may be given by a college or university affiliated with the laboratory.

The following findings are important to the perspective of medical technology education but are not statistically significant in their distribution:

> The majority of clinical education programs are directed by pathologists certified in both anatomical and clinical pathology and are supervised by ASCP-certified medical technologists.
>
> Weaknesses in medical technology education include insufficient pre-clinical preparation in biochemistry, bacteriology and physics; and inadequate clinical instruction in instrumentation, mathematics, clinical application of laboratory test results, and application of theory to practical aspects of laboratory work.
>
> Instruction in calculation of mean, standard deviation and range of quality control sample values is not sufficient to meet the working needs of medical technologists.
>
> Quality control in laboratory work appears to be practiced at a standard lower than desirable, owing possibly to insufficient instruction in such use during the educational program of medical technologists.

C. Inconclusive Observations

Apparent contradictions in questionnaire returns preclude a conclusion about the degree of independent judgment exercised by medical technologists in laboratory procurement of equipment, reagents, etc.; the use of quality control measures; consultation with immediate supervisors and those who request laboratory services; and definition of duties and responsibilities by immediate supervisors.

Lack of information about clinical lecture content and absence of pertinent questions in the July 1962 certification examination preclude a definitive conclusion regarding instruction in instrumentation, technical problem solving and application of quality control practicum in current education programs.

II. Pre-Clinical Program

In fulfilling the Registry prerequisites, all of the medical technologists surveyed in this study completed college courses in inorganic chemistry and at least one basic biological science (botany, biology, zoology). At least two-thirds of them completed one or more college courses in organic chemistry, quantitative analysis, bacteriology, physiology and/or anatomy. Nearly two-thirds had mathematics.

There appears to be a tendency for more of those who passed the July 1962 certification examination to receive satisfactory grades (A, B, and C) than those who failed, however, this is not a statistically significant difference. Significantly more of the technologists who failed received grades of D and F in courses in inorganic chemistry. botany and/or biology, physics, histology and genetics.

Satisfactory grades (A, B, and C) in a college science course do not appear to have influenced students toward subsequent concentration in a corresponding specialty of medical technology. It was found, for example, that there is no difference in the grades received (satisfactory and unsatisfactory) in college chemistry courses by specialists 2/ in chemistry and their colleagues in other specialties. Furthermore, generalists 3/ were found to have received satisfactory grades in more college courses than specialists, particularly those specializing in blood bank.

2/ A "specialist" is defined in this report as a technologist working in a single field of medical technology, such as hematology, microbiology, etc.

3/ A "generalist" is defined in this report as a technologist working in more than one field of medical technology.

On the subject of educational deficiencies, some medical technologists emphasized a need for better preparation in specific academic courses. Microbiology (especially bacteriology), chemistry (especially biochemistry) and physics were mentioned most often.

III. Clinical Program

There is a direct relationship between school directors' evaluations of students completing their clinical study in schools of medical technology and the technologists' subsequent performance in the July 1962 certification examination. Despite the subjective nature of the evaluations, significantly more of the technologists passing the examination were rated "excellent" or "good" in their clinical study than were those who failed the examination.

In addition, significantly more of the technologists possessing the degree of Bachelor of Science in Medical Technology passed the examination than did those with or without other degrees.

It appears that technologists who completed three years of pre-clinical study prior to clinical study performed better on the July 1962 certification examination than did those who completed two years of pre-clinical study. Furthermore, technologists performed better in this examination if their clinical study programs

1. included more than ten ASCP-certified medical technologists possessing bachelor's degrees among their technical staffs, and
2. were accredited for a maximum capacity in excess of eight students and actually graduated more than four students each year.

Significantly more of the clinical programs completed by the technologists who failed the July 1962 certification examination

1. accepted two years of pre-clinical study for entry;
2. had fewer than 11 ASCP-certified medical technologists with academic degrees on their technical staff; and
3. were accredited for and actually graduated fewer than five students.

These findings reflect a need for more than two years of pre-clinical preparation, better orientation to the practice of medical technology, and the motivation and mutual assistance available among larger groups of students.

The mycology portion of clinical programs may present greater difficulties for students than do other portions, judging by the lack of "excellent" ratings in this subject.

A substantial number of technologists felt that deficiencies in their clinical education were serious enough to warrant comment. The needs most often expressed favored more and better didactic preparation, application of theory to the practical aspects of laboratory work and clinical application of laboratory test results. Several technologists expressed a need for more thorough instruction in instrumentation.

Other than a count of clinical lectures and laboratory determinations, no information was presented regarding the content of the clinical year curriculum. Such information might reveal significant relationships between curriculum content and performance on the certification examination. The scope of the present study did not include provisions for this type of analysis. It is noted that the number of lectures attended and laboratory determinations performed was greater for the 271 technologists surveyed in this study than for all 1,861 technologists filing for the July 1962 examination, but neither of these factors appear to have influenced examination scores.

Finally, it is noted that students did not seem to be influenced in their selection of schools of medical technology by tuition requirements, or availability of stipends, and room and board.

IV. Certification Examination

A review of the questions in the July 1962 certification examination 4/ shows that it was directed primarily to material presented during the clinical study year. Only a few questions required application of mathematical ability and the derivation of mathematical formulae customarily used in the practice of medical technology. References to quality control procedures are indirect if they are there at all. There were no questions requiring the exercise of judgment in solving problems of chemical reactions, instrumentation or validation of results. These omissions are noteworthy because they reflect areas of job performance in which the technologists were rated lower by their supervisors. Inasmuch as the technologists surveyed were not examined in these aspects of laboratory practice, it is impossible to determine if they were included in previous education programs.

V. Working Environment

The medical technologists in this study had been working two or three years in laboratories throughout the country. Three-fourths of them were situated in hospitals which, on the average, were larger than hospitals in general. The average bed capacity of 387 for hospitals in the study is compared with 183 beds for accredited short-term hospitals and 126 beds for all accredited hospitals in the United States. The remaining one-fourth worked in non-hospital laboratories and were involved in research, public health and private practices.

The technologists working in hospitals with fewer than 200 beds undertook greater responsibility, exercised more independent judgment and were subject to less supervision in the performance of technical and administrative duties than technologists working in larger hospitals. Also, their particular duties and responsibilities were less clearly defined. These findings assume additional importance in view of the fact that fewer of them held bachelor's degrees than did the technologists in larger hospitals.

Distinction in working situations between specialists and generalists follows the usual concepts pertaining to functional requirements of those fields.

The following findings pertaining to the use of quality control procedures indicate inadequate instruction in this subject in the education programs of most of these technologists:

> Commercially available pools were used in quality control to a significantly greater extent than were any of the other five measures listed in the questionnaire. This reveals the possibility that most technologists tend to rely on control measures for which numerical values may not have been determined and verified according to the methods and conditions of the particular laboratory in which they are used.
>
> Almost as many of the technologists had learned on the job as had learned in school to calculate the mean, standard deviation and range of quality control sample values. As the need for this ability is evident, its development ought to have been included in medical technology education programs.
>
> On the other hand, half of the technologists reported that they maintained and used charts of control sample values when they were students. It is possible, therefore, that instruction in the practice of quality control was limited to this aspect which is only a part of a total program in the control of laboratory results.

4/ Certification examination administered by the Board of Registry of Medical Technologists (ASCP)

Despite this minimal background in quality control procedures,

1. 92% of the technologists felt they had been assigned the responsibility of exercising independent judgment in the performance of their duties; and
2. 74% reported having partial or total responsibility for procurement of laboratory equipment, reagents and other materials necessary in medical laboratory work.

Consequently, the question of the basis for making such decisions may be raised.

The following trend is encouraging, however; as the number of listed quality control measures used increases, there is a corresponding increase in the percent of technologists who

1. had teaching responsibilities;
2. were employed full time;
3. had calculated means, standard deviations and ranges of control sample values and had maintained charts of these values both as students and in their work;
4. were satisfied that their educational preparation was adequate for proper performance of duties assigned them; and
5. felt that their laboratory duties and responsibilities were clearly defined by their immediate supervisors.

Limitations of the questionnaire method in assessing utilization of quality control procedures became increasingly apparent as the study progressed. Accordingly, the inconclusive patterns evident in replies from both specialists and generalists for this topic are not surprising. A more intensive study of quality control utilization would require a considerable number of site visits and interviews.

VI. Job Performance Ratings

Approximately one-fourth of the laboratory supervisors who rated the medical technologists' job performance were directors of their laboratories and were, for the most part, Doctors of Medicine. The remaining three-fourths had various supervisory titles and were, primarily, ASCP-certified medical technologists. Half of the laboratory supervisors reporting had worked in medical laboratories longer than ten years and more than half had held their current appointments for five years or less. Eighty percent of them possessed academic degrees and 81% completed formal education in medical technology. The percent of supervisors attending programs in continuing education was larger than the corresponding percent of technologists they supervised.

The supervisors evaluated the job performance of their technologists in 60 items involving Skills, Dependability, Reliability, Initiative and Personal Relations. Statistical comparison shows no significant difference between the ratings for technologists who passed the July 1962 certification examination and those who failed it. Significantly more of the 193 technologists evaluated were rated above "average" in items of Dependability and more were rated "average" or lower in items involving Initiative. A significant segment of the technologists received ratings in 25 of the 60 items which varied from the norm of ratings for all of the 60.

The findings indicate that a significant number of medical technologists performed below expectation in five items directly related to technical aspects of their work and five items indirectly related to technical aspects. Although the qualities described in nine of the items in which more of the technologists were rated above "average" affect their job performance, they are non-technical in nature.

The subjectiveness inherent in the supervisors' evaluations should not be totally disregarded. Unfortunately, the scope of this report does not permit measurement of the extent to which these findings reflect more critical value judgments by the supervisors toward technical aspects of laboratory work than those toward non-technical aspects.

RECOMMENDATIONS

The following recommendations are based on the information obtained and conclusions derived during this study.

It is recommended that

1. American Medical Association accreditation standards for schools of medical technology be amended to require
    a. college or university affiliation,
    b. a minimum staffing requirement of ten medical technologists possessing bachelor's degrees, and
    c. a minimum capacity of eight students.

2. pre-clinical education programs for students of medical technology be strengthened through increased emphasis on bacteriology, biochemistry, physics and mathematics,

3. clinical education programs in schools of medical technology be strengthened through additional instruction in all aspects of quality control, instrumentation, practical application of theory to laboratory procedures, and clinical application of laboratory test results.

4. the certification examination administered through the Board of Registry of Medical Technologists (ASCP) be revised to include additional evaluation of knowledge, judgment and proficiency in instrumentation, technical problem solving, quality control and mathematics.

5. further studies, incorporating site visits and interviews, be undertaken to determine
    a. if the curricula and content of pre-clinical education programs leading to the degree of Bachelor of Science in Medical Technology vary significantly from other pre-clinical programs;
    b. if the curricula and content of clinical education programs embody factors contributing to the success of medical technology students and their proficiency in subsequent laboratory practice;
    c. the utilization of quality control practices in medical laboratories, the extent to which medical technologists are prepared to exercise judgment, and the contribution of both to the performance of laboratory work; and
    d. the degree of latitude employed by laboratory supervisors in judging performance of technologists relating to both technical and non-technical aspects of laboratory work, and if technologists generally fail to perform within the expectations and demands of their supervisors.

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A. PERFORMANCE IN PRE-CLINICAL STUDY

Evaluation of the pre-clinical study performance of the medical technologists surveyed is based on the credit hours and grades they received in the physical, biological and medical science courses taken in college prior to clinical study. Grades of A, B, and C were grouped arbitrarily as "satisfactory" performance and those of D and F as "unsatisfactory" for the purposes of this study.

College transcripts of credit hours and grades were available for 74% (332) of the study group in the office of the Registry of Medical Technologists (ASCP). For the remaining 26% (112), credit-hour information was obtained from special Registry forms.1/

All of the medical technologists surveyed completed courses in inorganic chemistry and a basic biological science (botany, biology and/or zoology). For electives in chemistry, two-thirds or more of the total population chose chemistry and quantitative analysis; while fewer than half chose qualitative analysis and/or biochemistry. For electives in biological and medical science, more than 85% of the total population chose bacteriology and more than 76% chose physiology and/or anatomy. Fewer than 40% elected courses in histology, parasitology, genetics, embryology, and eugenics (in descending order of frequency). More than 62% completed one or more courses in mathematics. Fewer than half took physics courses. (Table 1)

Transcripts of college grades were available for 332 medical technologists. Comparison of grades with the results of the July 1962 certification examination shows that significantly more of the technologists who failed the examination received grades of D and F in inorganic chemistry, botany and/or biology, physics, histology, and genetics.2/ There is a tendency for more of the technologists who passed the examination to receive grades of A, B, and C than did those who failed, although the distribution of technologists receiving them is not statistically significant.3/ (Table 2)

1/ Credit hours entered on the special Registry office forms were considered indicative of satisfactory performance because they had been accepted in fulfillment of prerequisites for clinical study. Grades of D were accepted. The error so introduced into the study is not known. The procedure employed in entering this and related data is detailed in the Appendix.

2/ $X^2 = 6.73$; df = 1, $X^2 = 3.84$ (Inorganic Chemistry)
$X^2 = 12.65$; df = 1, $X^2 = 3.84$ (Botany/Biology)
$X^2 = 9.05$; df = 1, $X^2 = 3.84$ (Physics)
$X^2 = 6.18$; df = 1, $X^2 = 3.84$ (Histology)
$X^2 = 8.14$; df = 1, $X^2 = 3.84$ (Genetics)

3/ $X^2 = 12.69$; df =16, X^2 =26.30 (ABC Pass vs Fail)
$X^2 = 23.02$; df =15, X^2 =25.00 (DF Pass vs Fail)

The data 4/ were organized to distinguish satisfactory from unsatisfactory performance for generalists and specialists in chemistry, microbiology, hematology, and blood bank. Although no significant difference occurred in the number of technologists who received D and F grades, there is a significant difference in the number of courses graded D and F. Specialists in blood bank received grades of D and F in significantly more courses and generalists received grades of D and F in significantly fewer courses.5/ (Table 3)

4/ All data in this report were subjected to the chi square test. Chi square (hereafter designated as X^2) measures the degree to which observed frequencies differ from expected frequencies. A large value for X^2 indicates lack of agreement; a small value indicates close agreement. The value for X^2 has a sampling distribution, as does any sample statistic. The shape of the distribution of X^2 differs according to degrees of freedom (df) which is a function of the number of cells involved in the calculation. Thus a value of X^2 in relation to df assists in the decision of whether or not a significant difference exists between observed and expected frequencies. Throughout this report, significant differences are determined at the 0.05 (5%) level of probability in all instances using the formula for chi square distribution. A sample application of the test is shown in the Appendix under the title "Methodology".

5/ $X^2 = 11.79$; df = 4, $X^2 = 9.49$

TABLE I

CREDIT HOURS AND GRADES FOR COLLEGE SCIENCE COURSES
Taken By
444 MEDICAL TECHNOLOGISTS[a]

College Science Course	Percent of 444 medical technologists with ABC grades[b]				Percent of 444 medical technologists with D F grades[b]			
	Taking Course	Number of credit hours			Taking Course	Number of credit hours		
		1-4	5-8	9 or more		1-4	5-8	9 or more
	%	%	%	%	%	%	%	%
Chemistry:								
Inorganic Chemistry	96	13	59	24	12	7	5	X[c]
Organic Chemistry	77	31	37	9	18	12	5	X[c]
Quantitative Analysis	66	50	15	1	12	10	2	X[c]
Qualitative Analysis.	42	33	9	0	4	3	1	0
Biochemistry.	35	20	13	2	2	1	1	X[c]
Biological and Medical Science:								
Botany &/or Biology	66	18	36	12	3	3	X[c]	0
Zoology	66	27	33	6	4	2	X[c]	X[c]
Bacteriology.	85	41	29	15	7	4	2	X[c]
Physiology &/or Anatomy . . .	76	32	35	9	7	6	1	X[c]
Histology	35	32	3	0	3	3	0	0
Parasitology.	34	31	2	X[c]	2	2	X[c]	0
Genetics.	28	26	2	X[c]	3	3	0	0
Embryology.	16	16	X[c]	0	2	2	X[c]	0
Eugenics.	3	2	0	X[c]	0	0	0	0
Mathematics.	62	24	30	8	17	13	3	X[c]
Physics.	48	16	26	6	8	4	3	X[c]

a. Includes information from transcripts of credit hours for 332 medical technologists and from summaries of transcripts prepared by the office of the Registry of Medical Technologists (ASCP) for 112 medical technologists. Information for 3 medical technologists could not be converted to a form for this analysis.

b. The data involving the medical technologists' grades in science courses were assigned to two groups to indicate satisfactory (A, B & C) and unsatisfactory (D & F) performance. The percentages represent the portion of people who received grades of A, B, & C as against D & F in the science courses listed. The ABC group may include those technologists who repeat courses because of previous failing grades.

c. X = less than 1%

TABLE 2

GRADES FOR COLLEGE SCIENCE COURSES
Taken By
MEDICAL TECHNOLOGISTS WHO PASSED AND FAILED
The
JULY 1962 CERTIFICATION EXAMINATION[a]

College Science Course	Percent of 332 Medical Technologists[b] with grades [c] of		Percent of 290 Passing Medical Technologists[b] with grades[c] of		Percent of 42 Failing Medical Technologists[b] with grades[c] of	
	A B C	D F	A B C	D F	A B C	D F
	PERCENT		PERCENT		PERCENT	
Chemistry:						
Inorganic Chemestry. .	96	16	97	14	95	33[d]
Organic Chemistry. . .	73	24	76	23	55	33[e]
Quantitative Analysis	66	16	69	16	45	21
Qualitative Analysis	39	6	40	6	31	5
Biochemistry	35	3	38	3	17	2
Biological and Medical Science:						
Botany &/or Biology. .	63	4	62	2	69	17[d]
Zoology.	67	5	67	5	64	5
Bacteriology	87	9	89	9	76	7
Physiology &/or Anatomy	75	10	74	10	83	10
Histology.	37	3	37	2	33	10[d]
Parasitology	34	3	36	3	21	2
Genetics	25	4	26	3	19	12[d]
Embryology	14	3	14	3	12	5
Eugenics	3	0	3	0	2	0
Mathematics.	78	23	79	21	67	33[e]
Physics.	47	10	50	9	31	21[d]

a. This refers to the examination given by the Board of Registry of Medical Technologists (ASCP) in July 1962 for certification of medical technologists.

b. Transcripts of credit hours were available for 332 of the 444 medical technologists including 290 of the 379 medical technologists who passed the examination and 42 of the 65 medical technologists who failed the examination. Information for 3 medical technologists could not be converted to a form for this analysis.

c. The data involving the medical technologists' grades in science courses were assigned to two groups to indicate satisfactory (A, B, and C) and unsatisfactory (D and F) performance. The percentages represent the portion of people who received grades of A, B, and C as against D and F in the science courses listed. The ABC group may include those technologists who repeat courses because of previous failing grades.

d. Calculation of chi square distribution shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 13-14)

e. Calculation of chi square distribution shows that these figures are close to being statistically significant (tendency) because the frequency of replies almost exceeds the 0.05 probability level ($X^2 = 3.22$ (Mathematics) and 3.72 (Organic Chemistry); df = 1, $X^2 = 3.84$).

TABLE 3

GRADES FOR COLLEGE SCIENCE COURSES
Taken By
MEDICAL TECHNOLOGISTS EMPLOYED
as
GENERALISTS AND IN CERTAIN SPECIALTIES[a]

College Science Courses	Percent of 88 Generalists with grades[b] of		Percent of 56 Chemistry Specialists with grades[b] of		Percent of 32 Microbiology Specialists with grades[b] of		Percent of 31 Hematology Specialists with grades[b] of		Percent of 20 Blood Bank Specialists with grades[b] of	
	ABC	DF	ABC	DF	ABC	DF	ABC	DF	ABC	DF
	Percent		Percent		Percent		Percent		Percent	
Chemistry:										
Inorganic Chemistry	94	16^c	96	9	97	6	100	3	100	15^c
Organic Chemistry	81	15	71	29^c	75	27^c	81	23^c	75	20^c
Quantitative Analysis	59	8	73	12	75	13	81	20^c	50	15^c
Qualitative Analysis	42	3	36	9^c	50	3	68	3	50	5
Biochemistry	35	1	52	4	27	3^c	35	6^c	35	5^c
Biological and Medical Science:										
Botany &/or Biology	65	2	66	0	66	3^c	71	0	70	10^c
Zoology	64	1	71	2	63	0	84	6^c	70	10^c
Bacteriology	89	2	93	12^c	81	0	81	0	90	10^c
Physiology &/or Anatomy	74	5	80	14^c	85	9^c	77	3	70	10^c
Histology	38	3^c	30	5^c	50	0	35	0	30	0
Parasitology	25	2^c	50	4^c	44	3^c	29	3^c	10	0
Genetics	31	2	29	0	31	0	32	0	20	5^c
Embryology	23	3	9	2	22	0	19	3^c	10	5^c
Eugenics	5	0	4	0	3	0	0	0	0	0
Mathematics	56	13	61	18^c	69	22^c	55	6	70	35^c
Physics	50	6	48	5	66	3	58	3	30	15^c

a. Data are shown for 227 of the 271 medical technologists employed in single and several fields of medical technology and whose transcripts of credit hours were available.

b. The data involving the medical technologists' grades in science courses were assigned to two groups to indicate satisfactory (A, B, & C) and unsatisfactory (D & F) performance. The percentages represent the portion of people who received grades of A, B, and C as against D and F in the science courses listed. The ABC group may include those technologists who repeat courses because of previous failing grades.

c. Calculation of chi square distribution shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 13-14)

B. PERFORMANCE IN CLINICAL STUDY

Each student's performance during his clinical study is rated by the director of the program. These evaluations, filed with the Registry of Medical Technologists (ASCP), are summarized in Table 4. Represented in this table are ratings of 444 medical technologists of whom 379 passed the certification examination and 65 failed.

Ratings were identified as "excellent", "good", "average", "poor" and "fail" in each section of a student's laboratory work. Table 4 shows the percent of students receiving each of these ratings according to nine laboratory divisions: bacteriology, blood bank, chemistry, hematology, histologic technique, mycology, parasitology, serology, and urinalysis. The mean values of these percentages provide a summary of clinical evaluation for the total population, those who passed and those who failed the examination.

According to these summaries, the mean values for ratings for the total population are
25% rated "excellent"
47% rated "good"
25% rated "average"
2% rated "poor", and
less than 1% rated "fail".
The only laboratory division in which ratings differ significantly from this pattern is mycology where more students were rated "average" or "poor".1/

The profile of mean values for the 379 technologists who passed the examination approximates that of the total population (27%, 48%, 22%, 1%, and 0%; respectively). By contrast, the mean ratings for the 65 technologists who failed the examination were 9%, 42%, 8%, and less than 1%; respectively.

Significantly more of those who passed the certification examination were rated "excellent" or "good" than were those who failed.2/ More of those who passed were rated "excellent" or "good" in all but two laboratory divisions.3/ These two divisions are blood bank and urinalysis in which more were rated "excellent".

1/ The statistical significance of distributions of clinical study performance ratings was determined by application of the Kolmogorov-Smirnov formula. This chi square distribution formula is used to determine whether or not two independent samples are from the same population with respect to a specific attribute.
X^2 = 11.27; df = 2, X^2 = 5.99

2/ X^2 = 14.75; df = 2, X^2 = 5.99

3/ X^2 = 7.91 through 26.13; (range) df = 2, X^2 = 5.99

TABLE 4

RATING OF PERFORMANCE IN CLINICAL STUDY[a]
For
MEDICAL TECHNOLOGISTS

Laboratory Division	Performance Rating				
	Excellent	Good	Average	Poor	Fail
	Percent of 444 Med. Technologists[b] Who Took Exam				
All laboratory divisions[c].	25	47	25	2	X[g]
Each laboratory division of					
Bacteriology.	27	42	27	3	X[g]
Blood Bank.	25	50	23	1	0
Chemistry	24	50	22	3	X[g]
Hematology.	27	48	23	1	0
Histologic Technique.	29	46	22	1	0
Mycology.	20	41[d]	33	5	0
Parasitology.	22	43	31	3	X[g]
Serology.	23	52	23	1	0
Urinalysis.	27	54	18	1	0
	Percent of 379 Med. Technologists Who Passed Exam				
All laboratory divisions[c].	27	48[e]	22	1	0
Each laboratory division of					
Bacteriology.	29	43[f]	25	1	0
Blood Bank.	29[e]	50	20	X[g]	0
Chemistry	27	52[f]	20	1	0
Hematology	30	49[f]	19	X[g]	0
Histologic Technique	31	47[f]	20	X[g]	0
Mycology	22	43[f]	31	3	0
Parasitology	24	46[f]	27	2	0
Serology	25	54[f]	19	X[g]	0
Urinalysis	29[e]	52	17	X[g]	0
	Percent of 65 Med. Technologists Who Failed Exam				
All laboratory divisions[c].	9	42	41	8	X[g]
Each laboratory division of					
Bacteriology.	12	34	40	12	2
Blood Bank	6	52	37	5	0
Chemistry	8	41	38	11	2
Hematology	8	46	43	3	0
Histologic Technique	15	45	34	6	0
Mycology.	6	29	49	15	0
Parasitology	11	23	55	9	2
Serology	6	45	46	3	0
Urinalysis	9	61	25	5	0

a. The term "clinical study" is defined as the study and practice of medical laboratory techniques in a medical laboratory accredited by the Council on Medical Education of the American Medical Association to be a school of medical technology. Students enrolled in and satisfactorily completing this aspect of the education program may receive credit hours from the college or university with which the laboratory is affiliated.

b. Information for three medical technologists was not available.

Footnotes for Table 4
(continued)

c. These percents represent the mean of the nine section percents which follow them.

d. Calculation of chi square distributions for laboratory divisions shows that these figures are statistically significant because the frequency exceeds the 0.05 probability level.

e. Calculation of chi square distributions for "Pass" and "Fail" groups (all laboratory divisions) shows that these figures are statistically significant because the frequency exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (page 18).

f. Calculation of chi square distributions for "Pass" and "Fail" groups (each laboratory division) shows that these figures are statistically significant because the frequency exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (page 18).

g. X = Less than 1%.

C. SCHOOLS OF MEDICAL TECHNOLOGY

The medical technologists surveyed were enrolled for clinical study in laboratories accredited as schools of medical technology by the Council on Medical Education of the American Medical Association with assistance from the Board of Schools of Medical Technology of the American Society of Clinical Pathologists. Information about the 723 schools accredited in 1961-62 was obtained from the schools directors' annual reports for that period which are filed in the office of the Board of Schools of Medical Technology.

The medical technologists in this study attended 263 of the 723 schools accredited during 1961. Each of 154 schools was attended by one technologist and each of 109 by two through six technologists.

The 263 schools are divided into two groups ("Passed Exam" and "Failed Exam") according to the technologists' certification examination performance. There are 231 schools in the "Passed Exam" group including 209 attended only by technologists who passed the examination and 22 by more who passed than failed. The 32 schools designated as the "Failed Exam" group includes 29 attended only by those who failed and 3 schools attended by more who failed than passed.

Throughout Section C the designation "all schools" will be used to indicate the 723 schools accredited during 1961. The term "survey schools" pertains to the 263 attended by the technologists participating in this study. Table 5 contains data for all schools, survey schools, "Passed Exam" group and "Failed Exam" group.

Location

Ohio (7%), Pennsylvania (6%), Illinois (6%) and California (6%) had more schools than other states in 1961. In comparison, the states having the largest number of survey schools were Michigan (9%), California (8%), and Ohio (7%). The survey schools were distributed throughout 46 states and the District of Columbia. Significantly more of the schools attended by those who failed the certification examination were in Kentucky, New York, Ohio and Tennessee.1/

Collegiate Affiliation

Eighty percent of all schools accredited in 1961 were affiliated with one or more colleges or universities for pre-clinical study. Affiliation with one college is maintained by 42% of all schools. The largest number of affiliations for one school is fifteen. Significantly more of the survey schools (87%) have college affiliations.2/ There is no significant difference in the number of affiliations of the schools attended by those who passed and failed the certification examination.3/

In 1961, the minimum requirement for admission to 54% of all schools was two years of pre-clinical study and for 39% was three years of such study. This pattern was reversed among the survey schools in that 44% required two years and 50% required three years.4/ Significantly more of the schools attended by the technologists who passed the examination (54%) required three years of pre-clinical study and more attended by those who failed (81%) required two years.5/

1/ $X^2 = 4.46$; df = 1, $X^2 = 3.84$ (Kentucky)
$X^2 = 5.66$; df = 1, $X^2 = 3.84$ (New York)
$X^2 = 14.40$; df = 1, $X^2 = 3.84$ (Ohio)
$X^2 = 5.66$; df = 1, $X^2 = 3.84$ (Tennessee)

2/ $X^2 = 11.66$; df = 4, $X^2 = 9.49$

3/ $X^2 = 3.55$; df = 4, $X^2 = 9.49$

4/ $X^2 = 9.17$; df = 2, $X^2 = 5.99$

5/ $X^2 = 21.48$; df = 2, $X^2 = 5.99$

Practically all (99%) of the accredited schools and all (100%) of the survey schools required 12 or more months of clinical study. Most of them (93% of all schools and 95% of survey schools) required just 12 months.

Graduates of 78% of all schools and 86% of survey schools received a bachelor's degree from an affiliated college or university upon completion of the clinical program.6/ The difference between the number of schools in the "Passed Exam" and "Failed Exam" groups with such affiliations is not significant.7/

Staff

The directors of almost all schools (99%) were pathologists. Those in 63% of all schools and 64% of survey schools were certified in both anatomical and clinical pathology. An additional 28% and 26%, respectively, were certified only in anatomical pathology; and 4% and 4% respectively, were certified only in clinical pathology. There is no significant difference in these distributions, nor in the "Passed Exam" and "Failed Exam" groups.8/

Teaching supervisors in 85% of all schools and 87% of survey schools were medical technologists (ASCP). Physicians were named as teaching supervisors in 5% of each of these groups. There is no significant difference in the number of schools having technologists and physicians as teaching supervisors.9/

The number of ASCP-certified medical technologists with academic degrees working in all schools differs significantly from that in survey schools because more of the survey schools employed larger numbers of these personnel. Forty-four percent of all schools and 30% of survey schools had from one through five of these personnel on their technical staffs. Twenty-eight percent of all schools and survey schools were staffed by from six through ten of these personnel. More than ten of these technologists worked in each of 26% of all schools and 41% of survey schools.10/ This is important in relation to the examination performance of students because 46% of the schools attended by those passing the examination employed more than ten ASCP-certified technologists with degrees and 53% of the schools attended by those failing the examination employed fewer than six.11/

Other staff qualifications did not differ significantly between all schools and survey schools and "Passed Exam" and "Failed Exam" groups.12/

Size

Table 5 classifies size of schools according to three categories: accredited capacity, enrollment, and number of graduates.

Maximum student capacity is stipulated when schools of medical technology are accredited. When compared with all schools, the survey schools are accredited for larger numbers of students. In all schools, 29% were accredited for two through four students, 35% for five through eight students, and 36% for more than eight. In comparison, 16% of the survey schools were accredited for two through four students, 30% for five through eight, and 54% for more than eight. These

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6/ X^2 = 8.88; df = 1, X^2 = 3.84
7/ X^2 = 2.07; df = 1, X^2 = 3.84
8/ X^2 = 0.90; df = 5, X^2 = 11.07 (Schools)
X^2 = 4.84; df = 5, X^2 = 11.07 ("Pass", "Fail" groups)
9/ X^2 = 0.01; df = 1, X^2 = 3.84 (Schools)
X^2 = 1.45; df = 1, X^2 = 3.84 ("Pass", "Fail" groups)
10/ X^2 = 27.22; df = 3, X^2 = 7.81
11/ X^2 = 18.73; df = 2, X^2 = 5.99
12/ X^2 = 1.46; df = 3, X^2 = 7.81 (Non-M.T.(ASCP), Degree) (Schools)
X^2 = 1.96; df = 3, X^2 = 7.81 (M.T.(ASCP), No Degree) (Schools)
X^2 = 2.90; df = 3, X^2 = 7.81 (Technical Assistants) (Schools)
X^2 = 2.08; df = 3, X^2 = 7.81 (Non-M.T.(ASCP), Degree) ("Pass", "Fail" groups)
X^2 = 2.95; df = 3, X^2 = 7.81 (M.T.(ASCP), No Degree) ("Pass", "Fail" groups)

are statistically significant distributions.[13] Significantly more of the schools attended by those who passed the certification examination (58%) were accredited for more than eight students, and more attended by those who failed (38%) were accredited for two through four students.[14]

Another classification for size is actual enrollment. The survey schools, individually, enrolled significantly more students than did all schools. According to the 1961 annual reports, 44% of all schools enrolled fewer than five students; whereas 28% of the survey schools did so. More than eight students were enrolled in 23% of all schools and 38% of survey schools. This difference is statistically significant.[15] Enrollment did not differ significantly in relation to schools attended by students passing or failing the examination.[16]

A third classification is number of graduates. According to the 1962 annual reports, 51% of all schools graduated from one through four students, 26% graduated from five through eight, and 11% graduated more than eight. The corresponding figures for the survey schools are 40%, 35%, and 23%. Thus, the survey schools differ significantly from all schools in graduating more students.[17] Also, significantly more of the schools attended by students who passed the examination (38%) graduated from five through eight students; while more attended by those who failed (66%) graduated from one through four students.[18]

The distribution of students taking, passing and failing the July 1962 certification examination followed a pattern similar to that of the number of graduates. In 53% of all schools, from one through four students took the examination, in 23% from five through eight took it, and in 11% more than eight took the examination. The corresponding percentages for the survey schools are 41%, 33%, and 24%.[19] Significantly more of the schools attended by those who passed the examination (36%) had from five through eight students taking it, and more attended by those who failed (69%) had fewer than five taking it.[20]

Some discrepancies appear in the information reported in Table 5 in the percentages associated with numbers of technologists graduating and taking, passing and failing the certification examination. For example, some schools reported having no graduates and some attended by technologists who failed the examination reported no failures. These discrepancies are due to variations in reporting periods for the schools and could not be clarified by existing sources of information.

Financing

Only 16% of all schools charged tuition for clinical study. Significantly more of the survey schools (22%) charged tuition for their programs.[21] There were tuition charges in significantly more of the schools attended by the technologists who passed the examination (25%) and no charges in more attended by those who failed (97%).[22]

Stipends were paid to students in 56% of all schools and 52% of survey schools. This difference is not significant nor is that for the examination performance groups.[23]

Room and/or board was provided by 74% of all schools and survey schools. There is no significant difference in the distributions for this item.[24]

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[13] $X^2 = 31.07$; df = 2, $X^2 = 5.99$

[14] $X^2 = 14.77$; df = 2, $X^2 = 5.99$

[15] $X^2 = 43.74$; df = 2, $X^2 = 5.99$

[16] $X^2 = 6.19$; df = 3, $X^2 = 7.81$

[17] $X^2 = 53.68$; df = 3, $X^2 = 7.81$

[18] $X^2 = 17.35$; df = 3, $X^2 = 7.81$

[19] $X^2 = 61.86$; df = 3, $X^2 = 7.81$

[20] $X^2 = 21.54$; df = 3, $X^2 = 7.81$

[21] $X^2 = 4.79$; df = 1, $X^2 = 3.84$

[22] $X^2 = 7.60$; df = 1, $X^2 = 3.84$

[23] $X^2 = 1.26$; df = 1, $X^2 = 3.84$ (Schools)
$X^2 = 0.34$; df = 1, $X^2 = 3.84$ ("Pass", "Fail" groups)

[24] $X^2 = 1.03$; df = 1, $X^2 = 3.84$ (Schools)
$X^2 = 1.01$; df = 1, $X^2 = 3.84$ ("Pass", "Fail" groups)

Educational Programs

The majority of all schools (55%) and survey schools (61%) provided from 100 through 200 lectures in their clinical programs. Fewer than 100 lectures were offered in 22% of all schools and 19% of survey schools. More than 200 were offered in 15% of all schools and 18% of survey schools. There is no significant difference in any of these distributions.25/

A similar pattern existed for laboratory tests performed in 1961 in the schools' clinical services. The majority of all schools (59%) and survey schools (57%) performed 100,000 through 300,000 laboratory tests that year. Fewer than 100,000 tests were performed in 21% of all schools and 18% of survey schools, and more than 300,000 tests were done in 19% of all schools and 24% of survey schools. There is no significant difference in any of the distributions pertaining to this item.26/

25/ $X^2 = 2.58$; df = 2, $X^2 = 5.99$ (Schools)
$X^2 = 1.85$; df = 2, $X^2 = 5.99$ ("Pass", "Fail" groups)
26/ $X^2 = 5.62$; df = 3, $X^2 = 7.81$ (Schools)
$X^2 = 3.15$; df = 3, $X^2 = 7.81$ ("Pass", "Fail" groups)

SUMMARY
of
Schools of Medical Technology

COMPARISON: 263 Survey Schools versus 723 Accredited Schools

The survey schools were not typical of all schools accredited in 1961 because, in general, they tend to be larger in most respects. The statistically significant differences are given below.

Significantly more of the survey schools

- * were affiliated with one or more colleges or universities; (87% of survey schools vs. 80% of all schools)
- * required a minimum of three years of pre-clinical study prior to admission; (50% vs. 39%)
- * had college/university affiliations which gave bachelor's degrees for completion of the clinical program; (86% vs. 78%)
- * employed more than ten ASCP-certified medical technologists with academic degrees; (54% vs. 36%)
- * were accredited for more than eight students in 1961; (54% vs. 36%)
- * enrolled more than eight students in 1961; (38% vs. 23%)
- * graduated more than eight students in 1962; (23% vs. 11%)
- * charged tuition; (22% vs. 16%)

COMPARISON: "Passed Exam" Group (231 Schools) versus
"Failed Exam" Group (32 Schools)

Of the survey schools attended by the medical technologists who passed the July 1962 certification examination, significantly more

- * required three years of pre-clinical study prior to admission; (54% of "Passed Exam" group vs. 19% of "Failed Exam" group)
- * employed more than ten ASCP-certified medical technologists with academic degrees; (46% vs. 6%)
- * were accredited for more than eight students in 1961; (58% vs. 31%)
- * graduated more than four students in 1962; (63% vs. 28%)
- * charged tuition: (25% vs. 3%)

COMPARISON: "Failed Exam" Group (32 Schools) versus
"Passed Exam" Group (231 Schools)

Of the survey schools attended by the medical technologists who failed the July 1962 certification examination, significantly more

- required two years of pre-clinical study for admission; (81% of "Failed Exam" group versus 39% of "Passed Exam" group)
- employed fewer than 11 ASCP-certified medical technologists with academic degrees; (91% vs. 54%)
- were accredited for from two through four students in 1961; (38% vs. 13%)
- graduated fewer than five students in 1962; (66% vs. 36%)
- did not charge tuition; (97% vs. 75%)
- were located in Kentucky (9% vs. 2%), New York (3% vs. less than 1%), Ohio (25% vs. 4%) and Tennessee (9% vs. 2%)

TABLE 5

CHARACTERISTICS OF SCHOOLS OF MEDICAL TECHNOLOGY[a]

Item	Schools of Medical Technology			
	All Accredited in 1961	Attended by Medical Technologists in the Study		
		All	Passed Exam[b]	Failed Exam[b]
Number of medical technology schools surveyed	723	263	231	32
PERCENT of medical technology schools with the following characteristics	%	%	%	%
State Location				
California	6	8	9	0
Illinois	6	5	5	6
Kentucky	2	3	2	9[d]
Michigan	5	9[d]	9	6
Minnesota	5	3	3	0
New York	5	1	x[c]	3[d]
Ohio	7	7	4	25[d]
Pennsylvania	6	5	5	0
Tennessee	3	3	2	9[d]
Texas	5	6	6	6
All other states[e]	50	50	54	34
Affiliation with colleges or universities				
0 colleges or universities	20	13[d]	12	19
1 college or university	42	42	42	44
2 colleges or universities	18	17	18	13
3 colleges or universities	9	14	13	19
4 or more colleges or universities	11	14	15	6
Entrance requirement for pre-clinical study				
2 years	54[d]	44	39	81[d]
3 years	39	50[d]	54[d]	19
4 years	6	6	7	0
No reply	1	0	0	0
Length of clinical study				
Less than 12 months	1	0	0	0
12 months	93	95	94	97
13 through 18 months	6	5	6	3
Bachelor's degree granted by affiliating college or university				
Yes	78	86[d]	87	78
No	6[d]	3	3	3
No reply	16	10	9	19

TABLE 5

CHARACTERISTICS OF SCHOOLS OF MEDICAL TECHNOLOGY[a] (continued)

Item	Schools of Medical Technology			
	All Accredited in 1961	Attended by Medical Technologists in the Study		
		All	Passed Exam[b]	Failed Exam[b]
Number of medical technology schools surveyed	723	263	231	32
PERCENT of medical technology schools with the following characteristics (continued)	%	%	%	%
School Directors				
Pathologists certified in				
anatomical & clinical pathology	63	64	64	72
anatomical pathology only	28	26	27	19
clinical pathology only	4	4	4	3
Pathologists not certified in				
either anatomical or clinical pathology .	1	1	X[c]	3
Pathologists' certification not given . . .	3	3	4	0
Non-pathologist	1	1	X[c]	3
Changed School Directors in 1961				
Yes	6	5	4	6
No.	92	93	94	94
No reply	2	2	2	0
Teaching Supervisors				
Medical Technologist (ASCP)	85	87	87	84
Physicians.	5	5	4	9
Other	9	7	8	3
No reply.	1	X[c]	0	3
Technical Staff				
With degree: M.T. (ASCP)				
0	3	X[c]	X[c]	3
1 through 5	44[d]	30	27	53[d]
6 through 10	28	28	27	38
11 or more[g]	26	41[d]	46[d]	6
With degree: M.T. (other than ASCP)				
0	28	25	25	28
1 through 5	56	57	56	63
6 through 10	9	9	10	3
11 or more[h].	7	9	9	6
Without degree: M.T. (ASCP)				
0	15	16	16	9
1 through 5	63	59	58	69
6 through 10	18	19	20	13
11 or more[i].	4	6	6	9

TABLE 5

CHARACTERISTICS OF SCHOOLS OF MEDICAL TECHNOLOGY[a]
(continued)

Item	Schools of Medical Technology			
	All Accredited in 1961	Attended by Medical Technologists in the Study		
		All	Passed Exam[b]	Failed Exam[b]
Number of medical technology schools surveyed	723	263	231	32
PERCENT of medical technology schools with the following characteristics (continued)	%	%	%	%
Technical Staff (continued)				
Without degree: Lab. Assistant				
0	4	7	7	6
1 through 5	37	37	39	28
6 through 10	30	28	27	34
11 or more[j]	29	28	27	31
Student capacity accredited in 1961				
2 through 4 students	29	16[d]	13	38[d]
5 through 8 students	35	30	29	31
9 or more students[k]	36	54[d]	58[d]	31
Student enrollment in 1961				
0 students[l]	6	1	X[c]	3
1 through 4 students	44	28[d]	26	41
5 through 8 students	27	33	34	28
9 or more students[m]	23	38[d]	40	28
Students graduated in 1962				
0 students	11	2	X[c]	6
1 through 4 students	51	40	36	66[d]
5 through 8 students	26	35	38[d]	16
9 or more students[n]	11	23[d]	25	12
Students taking certification exam in 1962				
0 students	13	1	X[c]	6
1 through 4 students	53	41	38	69[d]
5 through 8 students	23	33	36[d]	12
9 or more students[o]	11	24[d]	26	12
Students passing certification exam in 1962				
0 students	16	3	1	19
1 through 4 students	54	45	43	63[d]
5 through 8 students	20	30	32[d]	12
9 or more students[p]	10	21[d]	23[d]	6
Students failing certification exam in 1962				
0 students	70	66	74[d]	12
1 through 4 students	29	33	25	88[d]
5 through 8 students	X[c]	1	1	0
9 or more students[q]	X[c]	X[c]	X[c]	0

TABLE 5

CHARACTERISTICS OF SCHOOLS OF MEDICAL TECHNOLOGY[a]
(continued)

Item	Schools of Medical Technology			
	All Accredited in 1961	Attended by Medical Technologists in the Study		
		All	Passed Exam[b]	Failed Exam[b]
Number of medical technology schools surveyed	723	263	231	32
PERCENT of medical technology schools with the following characteristics (continued)	%	%	%	%
Charged student tuition				
Yes.	16	22[d]	25[d]	3
No	83	78	75	97[d]
Stipends paid to students				
Yes.	56	52	52	47
No	44	48	48	53
Provide room and board				
Room only.	X[c]	X[c]	X[c]	0
Board only	22	24	24	22
Room and board	24	22	21	28
Neither room and board	53	54	54	50
Lectures given				
Fewer than 100 per year	22	19	20	12
100 through 200 per year	55	61	60	69
More than 200 per year	15	18	19	12
No reply	8	2	1	6
Laboratory tests performed in 1961				
Fewer than 100,000	21	18	18	19
100,000 through 300,000.	59	57	55	69
300,000 through 500,000.	13	14	16	6
More than 500,000.	6	10	11	6

a. "Schools of Medical Technology" refer to medical laboratories accredited by the Council on Medical Education of the American Medical Association for offering clinical study in the medical technology education program.

b. The 263 schools of medical technology attended by the medical technologists in the study are divided into two groups on the basis of the technologists' certification examination performance. The 231 schools designated as the "Passed Exam" group includes 209 attended only by those who passed the certification examination and 22 by more who passed than failed. The 32 schools designated as the "Failed Exam" group includes 29 attended only by those who failed and 3 schools attended by more who failed than passed.

c. X = Less than 1%.

d. Calculation of chi square distribution shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 21-24).

Footnotes for Table 5
(continued)

e. Each of the states included in the percent of "all other states" has fewer than 5% of the schools for each category. The schools attended by the study group are located in the District of Columbia and 46 of the 50 states. Those in the "Passed Exam" group are located in 46 states. Those in the "Failed Exam" group are in 15 states and the District of Columbia.

f. The largest number of colleges or universities affiliated with one of the 723 schools and the "Passed Exam" group is 15, and of the "Failed Exam" group is 4.

g. The largest number of ASCP-certified medical technologists with degrees per school in the 723 schools and the "Passed Exam" group is 76, and of the "Failed Exam" group is 21.

h. The largest number of medical technologists (other than ASCP) with degrees per school in the 723 schools is 47, in the "Passed Exam" group is 35, and in the "Failed Exam" group is 12.

i. The largest number of ASCP-certified medical technologists without degrees per school in the 723 schools is 26, in the "Passed Exam" group is 18, and in the "Failed Exam" group is 22.

j. The largest number of laboratory assistants per school in the 723 schools and in the "Failed Exam" group is 80, and in the "Passed Exam" group is 60.

k. The largest number of students accredited per school in the 723 schools is 70, in the "Passed Exam" group is 60, and in the "Failed Exam" group is 31.

l. Replies indicating "0 students" enrolled in 1961; graduated in 1962; and taking, passing and failing the certification examination reveal inconsistencies in the schools' annual reports and Registry office records which could not be clarified from the existing sources of information. These probably reflect variations in schools' fiscal years, students who failed previous examinations and passed them in July 1962, and reporting of students' success in November as well as July examinations.

m. The largest number of students enrolled in 1961 per school in the 723 schools is 70, in the "Passed Exam" group is 51, and in the "Failed Exam" group is 25.

n. The largest number of students graduated in 1962 per school in the 723 schools and the "Passed Exam" group is 35, and in the "Failed Exam" group is 14.

o. The largest number of students taking the 1962 certification examination per school in the 723 schools and the "Passed Exam" group is 32, and in the "Failed Exam" group is 14.

p. The largest number of students passing the 1962 certification examination per school in the 723 schools and the "Passed Exam" group is 30, and in the "Failed Exam" group is 13.

q. The largest number of students failing the 1962 certification examination per school in the 723 schools and the "Passed Exam" group is 10, and in the "Failed Exam" group is 3.

D. PERFORMANCE IN CERTIFICATION EXAMINATION

Raw scores and other information related to the July 1962 certification examination for medical technologists were provided by the office of the Registry of Medical Technologists (ASCP). The examination consisted of 200 questions divided among subjects as shown in Table 6.

The minimum raw score for passing the examination was 106 points. The mean raw score for the 1,861 people who took the examination was 127.32, with a range of 51 to 176 points. The mean raw score calculated for the 447 people selected for this study is 128.63 with a range of 66 to 173 points. Table 6 shows means and ranges for each section of the examination. The proximity of these means and ranges, both for the entire examination and for each section, is evidence that the sample of people obtained for this study from the total population is statistically random.

Means and ranges for those of the survey group who passed and those who failed were calculated, but are not shown in Table 6. Those who passed had a mean raw score of 135 points, with a range of 106 to 173. Those who failed had a mean of 92 points, with a range of 66 to 105 points.

Other sections of these findings show the relationship of performance on this certification examination to other factors in the education and job performance of medical technologists.

TABLE 6

RAW SCORES
for
JULY 1962
MEDICAL TECHNOLOGIST CERTIFICATION EXAMINATION

Sections of Examination	Certification Examination Raw Scores				
	Maximum Score	Mean		Range	
		All Examined (1,861)	Study Group (447)	All Examined (1,861)	Study Group (447)
All Sections	200	127.32	128.63	51-176	66-173
Each Section:					
Bacteriology	30	17.93	18.19	4-29	5-28
Blood Bank	15	9.88	9.87	2-15	3-14
Chemistry	30	18.87	19.37	6-29	10-28
Hematology	30	20.69	20.64	4-30	6-30
Histology	10	4.25	4.28	0-10	0- 9
Miscellaneous	35	24.53	24.84	6-35	11-35
Mycology	5	2.57	2.66	0- 5	0- 4
Parasitology	15	8.91	9.16	0-15	1-15
Serology and Immunology	15	9.54	9.81	1-15	1-15
Urinalysis	15	10.51	10.25	2-15	3-15

E. CHARACTERISTICS OF MEDICAL TECHNOLOGISTS

The medical technologists surveyed in this study were selected from 1,861 candidates examined for certification by the Board of Registry of Medical Technologists (ASCP) in July 1962.1/ Questionnaires were sent during March 1965 to 447 (24%) of the 1,861 examinees by the National Council on Medical Technology Education.2/ They were returned by 332 (72%) of the 447 examinees.

The survey population was reduced further to 271 technologists who were working in their profession currently or within six months prior to receiving the questionnaire. The information they returned appears in Tables 7, 8, and 9. The data in Table 7 are distributed among non-hospital laboratories 3/ and laboratories in hospitals of various sizes. Table 8 presents the data as they relate to specialists and generalists.4/ In Table 9 the data are distributed according to the number of quality control measures used by the technologists.

Educational Experience

The selection of technologists was limited to examinees in three categories of educational background defined by the Registry of Medical Technologists (ASCP) and explained in the section on "Methodology" in the Appendix. The categories are represented by the examinees in the following proportions:

Education Group 3:	Individuals completing four years of higher education of which three are in pre-clinical and one in clinical study but not having a bachelor's degree.5/	13%
Education Group 5:	Individuals with educational preparation as described in Group 3 and possessing the degree of Bachelor of Science in Medical Technology.	62%
Education Group 6:	Individuals completing five years of higher education of which four years are in pre-clinical and one in clinical study and having a bachelor's degree.	25%

One-third of the technologists without degrees failed the certification examination, whereas about 10% of those possessing degrees failed it. These percentages are applicable to the survey group (271) and the total population (1,861).

1/ The description of sample selection is in the Methodology section in the Appendix.

2/ Sample questionnaires are in the Appendix.

3/ The laboratories situated outside of hospitals will be referred to as "non-hospital laboratories".

4/ A "specialist" is defined in this report as a technologist working in a single field such as hematology, microbiology, etc.
A "generalist" is defined in this report as a technologist working in more than one field.

5/ "Pre-clinical study" refers to the academic study of physical, biological and medical sciences and elected liberal arts courses in a college or university accredited by an agency recognized by the American Council on Education and National Commission on Accrediting.
"Clinical study" refers to the study and practice of laboratory techniques in a medical laboratory accredited as a school of medical technology by the Council on Medical Education of the American Medical Association. Credit hours for clinical study may be given by a college or university affiliated with the laboratory.

Significantly more technologists without degrees worked in hospitals having fewer than 200 beds and more with degrees worked in those with more than 400 beds and in non-hospital laboratories.6/ Differences in distribution of generalists and specialists among the three education groups are not significant.7/

Type of Laboratory

The 271 technologists worked in 46 states and Canada. The largest group (10%) was in California. Sixty-two percent of the technologists were working in the state where they completed their clinical study.

About three-fourths of them worked in hospital laboratories. The average capacity of these hospitals was 387 beds and 40 bassinets. This capacity is greater than the average of 183 beds and 21 bassinets for all accredited short-term United States hospitals in 1964.8/ The other technologists (24%) were situated outside of hospitals in private laboratories, doctors' offices, clinics, public health, hospital or industrial laboratories involved in research, or industrial clinical laboratories.

Forty-five percent of the study group were generalists of whom significantly more worked in hospitals with fewer than 200 beds and in non-hospital laboratories.9/ The remaining 55% were specialists in chemistry (21%), microbiology (13%), hematology (11%), blood bank (7%), and histopathology, cytology, and urinalysis (3%). There is no significant difference in the distribution of specialists among various laboratories.10/

The laboratory directors employing 68% of the technologists were available full time. They served on a part time or consultant basis for 10% of the technologists. The remaining technologists (22%) did not answer this question. Significantly more of the medical technologists in hospitals with fewer than 200 beds , as well as specialists in blood bank, and generalists had part time or consultant directors.11/

The laboratory director for 80% of the technologists was a pathologist including 55% full-time and 7% part-time or consultant basis. Significantly fewer of the technologists in non-hospital laboratories had directors who were pathologists.12/ There is no significant difference in the number of generalists and specialists whose laboratory directors were pathologists.13/

Working Environment

According to the analysis of types of appointments held by the technologists, 67% were non-supervisory ("staff") positions, 24% were supervisory and 9% were research or other types. Significantly more of those in hospitals with fewer than 200 beds have supervisory appointments than do those in larger hospitals.14/ Most of the research technologists work in non-hospital laboratories. Although the proportion of technologists in blood banks holding supervisory positions is larger than those that are not, the comparison with other specialties shows such differences to be insignificant.15/

6/ $X^2 = 15.89$; df = 6, $X^2 = 12.59$
7/ $X^2 = 15.22$; df =10, $X^2 = 18.31$
8/ Hospitals, Journal of the American Hospital Association, Guide Issue, Part 2; 39: 15, 448-485 (August) 1965 (Tables 1, 5, and 7)
9/ $X^2 = 35.92$; df = 3, $X^2 = 7.81$
10/ $X^2 = 12.43$; df = 9, $X^2 = 16.92$
11/ $X^2 = 28.27$; df = 4, $X^2 = 9.49$ (Laboratories)
$X^2 = 16.81$; df = 5, $X^2 = 11.07$ (Specialist-Generalist)
12/ $X^2 = 69.28$; df = 3, $X^2 = 7.81$
13/ $X^2 = 2.67$; df = 5, $X^2 = 11.07$
14/ $X^2 = 8.80$; df = 2, $X^2 = 5.99$
15/ $X^2 = 7.10$; df = 4, $X^2 = 9.49$

Thirty-eight percent of the appointments included teaching responsibilities which encompass practical instruction at the laboratory bench, lectures or supervision of teaching programs. Significantly more technologists who worked in hospitals with more than 200 beds had teaching responsibilities.16/ Significantly more technologists employed in microbiology were teaching, whereas more generalists and chemistry specialists were not.17/ Significantly more of the supervisory positions included teaching responsibilities than did non-supervisory positions.18/ The duties of teaching supervisor were combined with those of chief technologist or section supervisor for significantly more of the technologists who worked in hospitals with fewer than 200 beds.19/

Most (87%) of the technologists worked full time. The various combinations of day, night and weekend hours reported are shown in Tables 7 and 8. Significantly more of the technologists in hospitals with fewer than 200 beds worked a schedule combining day, night and weekend hours; and more of those in non-hospital laboratories worked day hours only.20/ Significantly more hematology specialists worked a schedule including day, night and weekend hours; and more in histopathology-cytology-urinalysis worked day hours only.21/

Employment turnover is indicated by the tenure of their appointments held in the spring of 1965 (approximately three years after taking the certification examination). About one-fourth (27%) of the technologists had been working at their current places of employment for less than one year, 25% for two years, 41% for three years, and 7% for more than three years.

Many medical technologists changed positions or duties within their places of employment. Thirty-seven percent were engaged in their current positions less than one year, 28% for one to two years, 33% for two to three years, and 2% longer than three years. Length of service in a single laboratory or position did not vary significantly among various types of laboratories or specialties. 22/ These data indicate that technologists with greater tenure in a single laboratory were more likely than others to change positions within the laboratory.

Most (93%) of the technologists reported that they consulted their immediate supervisors for assistance with laboratory problems daily (38%), weekly (28%) and monthly or seldom (27%). The frequency of consultation in various types of laboratories and specialties does not very significantly.23/

Seventy-seven percent of the medical technologists said they freely discussed problems concerning laboratory tests or conferred about patients' conditions with physicians or others requesting work in their laboratories. Significantly more of the technologists in hospitals with fewer than 200 beds discussed these problems and more in hospitals with 200 through 399 beds did not discuss them.24/ Significantly more specialists in microbiology discussed these problems and more in chemistry and hematology did not discuss them.25/

Decisions about purchasing equipment, reagents, etc. in the laboratory were made by 74% of the technologists. Significantly more technologists in non-hospital laboratories and those in hospitals with fewer than 200 beds made these decisions.26/ Significantly more technologists in microbiology and more generalists made these decisions.27/

16/ $X^2 = 10.50$; df = 3, $X^2 = 7.81$
17/ $X^2 = 24.84$; df = 5, $X^2 = 11.07$
18/ $X^2 = 25.54$; df = 2, $X^2 = 5.99$
19/ $X^2 = 17.35$; df = 6, $X^2 = 12.59$
20/ $X^2 = 33.33$; df = 6, $X^2 = 12.59$
21/ $X^2 = 24.06$; df =10, $X^2 = 18.31$
22/ $X^2 = 10.23$ and 8.11; df = 6, $X^2 = 12.59$ (Laboratories)
$X^2 = 8.34$ and 5.64; df =10, $X^2 = 18.31$ (Specialist-Generalist)
23/ $X^2 = 5.74$; df = 6, $X^2 = 12.59$ (Laboratory)
$X^2 = 21.45$; df =15, $X^2 = 25.00$ (Specialist-Generalist)
24/ $X^2 = 16.78$; df = 3, $X^2 = 7.81$
25/ $X^2 = 14.53$; df = 4, $X^2 = 9.49$
26/ $X^2 = 23.64$; df = 6, $X^2 = 12.59$
27/ $X^2 = 27.06$; df =10, $X^2 = 18.31$

Seventy-seven percent of the technologists said that their immediate supervisors had clearly defined their duties and responsibilities for them. Significantly more technologists in hospitals with fewer than 400 beds said these had not been clearly defined, whereas those in non-hospital laboratories and hospitals with more than 400 beds said they had been.28/ There is no significant difference in the distribution of replies from specialists and generalists.29/

Ninety-two percent of the technologists said they felt they had been given responsibility to use independent judgment in performing their duties. There is no significant difference in the distribution of replies according to specialization and laboratory location.30/

Educational Preparation

Adequacy of educational preparation was an item of concern to some of the technologists. Although 81% of them expressed satisfaction in this matter, 29% commented about the need for additional education. Many of the latter said they had not been adequately prepared for tasks required in their work. These comments did not emphasize one specialty over another, nor reflect any one type of laboratory.31/

Seventy-seven of the 271 medical technologists submitted 123 separate comments about the need for additional preparation of which 48% pertained to specific academic courses. Those mentioned most frequently are
- microbiology (11%) including bacteriology (8%) and mycology (3%);
- chemistry (11%) including biochemistry (8%), organic (2%) and quantitative analysis (1%); and
- physics (5%) including physics (4%) and electronics (1%).

Other courses mentioned in decreasing order of frequency are parasitology, mathematics, abnormal hematology, anatomy, physiology, management, education and psychology, teaching methods, histology, and pharmacology.

Deficiencies in clinical programs provoked 26% of the 123 comments. Those occurring most frequently pertain to needs for more lectures, application of theory to practical aspects of laboratory work, and clinical application of laboratory test results. Other comments refer to a need to learn current methods for determinations, become informed about laboratory methods not used where clinical study was undertaken, learn to order supplies, and "poor training" generally.

Instrumentation was mentioned in 17% of the comments about clinical instruction deficiencies. Most of them pertain to needs for instruction in maintenance, trouble-shooting, and calibration of equipment.

Eight percent of the comments contained miscellaneous remarks such as "did not learn body fluid cell counts", "college substandard", and "no need for professional education in this job because all of the laboratory staff are paid the same salary".

The distribution of replies relevant to educational deficiencies is not significant.32/

Eighty-six percent of the medical technologists listed laboratory determinations learned "on the job" that had not been learned during their educational program. The type of laboratory involved is not significant.33/ However, this group (86%) was composed of significantly more specialists in chemistry and microbiology and fewer generalists.34/ Altogether, they listed 104 laboratory determinations and activities including use of instruments; and procedures for enzymes, coagulation, special stains, atypical antibody testing, differential identification of bacteria, gasometric analysis, and quality control.

28/ $X^2 = 9.92$; df = 2, $X^2 = 5.99$
29/ $X^2 = 9.69$; df = 5, $X^2 = 11.07$
30/ $X^2 = 4.60$; df = 3, $X^2 = 7.81$ (Specialist-Generalist)
$X^2 = 6.96$; df = 3, $X^2 = 7.81$ (Laboratories)
31/ $X^2 = 5.12$; df = 5, $X^2 = 11.07$ (Specialist-Generalist)
$X^2 = 0.73$; df = 3, $X^2 = 7.81$ (Laboratories)
32/ $X^2 = 6.32$; df = 3, $X^2 = 7.81$ (Laboratories)
$X^2 = 2.19$; df = 5, $X^2 = 11.07$ (Specialist-Generalist)
33/ $X^2 = 1.81$; df = 3, $X^2 = 7.81$
34/ $X^2 = 12.84$; df = 5, $X^2 = 11.07$

Conversely, 74% of the technologists listed laboratory determinations they learned as students but had not performed in their work. Distribution according to specialty and type of laboratory is not significant.35/ Sixty determinations were listed including use of instruments and cell count chambers; and procedures for icterus index, electrocardiogram, basal metabolism, antibody studies, and Folin-Wu method for glucose.

Many medical technologists evidenced interest in some form of continuing education. Twelve percent of them were attending graduate school. Forty percent said they attended meetings of professional organizations. Thirty percent attended seminars and 31% attended workshops. The distribution of replies by type of laboratory or specialty is not significant.36/ Thirty percent of the technologists reported that they had not participated in any of these forms of continuing education.

Use of Quality Control Measures

The medical technologists were asked to indicate certain quality control measures used in their work in appropriate instances. Seventy-five percent of them reported using commercially available pools. Standard solutions of known concentration were used by 68% and known positive samples by 51%. Other measures used were laboratory pooled samples of cells, plasma, hemoglobin, etc. (44%); duplicates of unknowns (33%) and recovery solutions (7%). There is no significant difference in the distribution of use of these measures according to the types of laboratories.37/ The distribution according to specialization shows that:

- commercially available pools were used by more generalists and chemistry specialists and fewer microbiology specialists;
- standard solutions by fewer microbiology specialists and more chemistry specialists;
- duplicates of unknowns by more hematology specialists and fewer generalists; and
- known positive samples by more microbiology and blood bank specialists and fewer chemistry specialists.

All of these differences are significant.38/

All of the quality control measures listed were not used in all of the specialty areas. The distribution of replies (Table 8) reflects the extent of their use. For example, microbiology and blood bank specialists use known positive samples for quality control more than other measures because of the nature of their work.

All except 7% of the technologists used one or more of these quality control measures. Fifteen percent of them used one of the six measures listed, 43% used two or three, and 35% used four or more. There is no significant difference in the number of measures used by various types of laboratories.39/ The distribution by specialty shows that significantly more specialists in hematology use two measures, more generalists use three or four measures, and more in chemistry use six measures. Significantly more specialists in microbiology, blood bank, and histology-cytology-urinalysis do not use any quality control measures.40/

The medical technologists were asked if they had calculated the mean, standard deviation and range of a quality control sample as students and in their work. Twenty-six percent reported having done so more than once as students, and 40% reported having done so more than once as professionals. There is no significant difference in the distribution of replies either by type of laboratory or specialty.41/

As the number of measures used increases, the number of technologists doing these calculations in their work also increases. The distribution of replies, however, did not exceed the 0.05 level of probability.42/

35/ $X^2 = 3.22$; df = 5, $X^2 = 11.07$ (Specialist-Generalist)
$X^2 = 5.46$; df = 3, $X^2 = 7.81$ (Laboratories)

36/ $X^2 = 4.50$; df = 9, $X^2 = 16.92$ (Laboratories)
$X^2 = 15.67$; df =15, $X^2 = 25.00$ (Specialist-Generalist)

37/ $X^2 = 16.02$; df =12, $X^2 = 21.03$

38/ $X^2 = 27.47$; df =16, $X^2 = 26.30$

39/ $X^2 = 21.00$; df =15, $X^2 = 25.00$

40/ $X^2 = 52.97$; df =25, $X^2 = 37.65$

41/ $X^2 = 1.77$; df = 3, $X^2 = 7.81$ (Laboratories)
$X^2 = 5.56$; df = 5, $X^2 = 11.07$ (Specialist-Generalist)

42/ $X^2 = 10.59$; df = 6, $X^2 = 12.59$

A related question asked if the respondents, as students and as professionals, maintained and used charts of control sample values to observe trend. Fifty-two percent said they did so as students and 55% reported doing so in their work. There is no significant difference in the distribution of replies either by type of laboratory or specialty.[43]

An increase in the number of technologists who had maintained such charts as students accompanies an increase in the number of measures used. Although the number of technologists maintaining charts in their work increases with the number of measures used, the trend is not as remarkable as in the above-mentioned comparison.

As the number of quality control measures used increases, so does the percent of technologists:
with teaching responsibilities,
employed full time,
whose duties and responsibilities were clearly defined by their immediate supervisors,
who felt adequately prepared by their education for the performance of assigned duties, and
who, as students and in their work, calculated the mean, standard deviation and range of control sample values and maintained charts of those values.

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[43] $X^2 = 1.48$; df = 3, $X^2 = 7.81$ (Laboratories)
$X^2 = 2.83$; df = 3, $X^2 = 7.81$ (Specialist-Generalist)

SUMMARY
of
Characteristics of Medical Technologists

DISTINCTIONS PERTAINING TO PLACE OF EMPLOYMENT

The following statements summarize the distinctions attributable to the type of laboratory employing the medical technologists surveyed.

Significantly more of the medical technologists employed in laboratories in hospitals with fewer than 200 beds

- did not hold bachelor's degrees;
- worked as generalists (i.e., in more than one field of medical technology);
- worked under part-time or consultant laboratory directors;
- held supervisory positions;
- were teaching supervisors in addition to being laboratory supervisors;
- worked a combined schedule of day, night and weekend hours;
- freely discussed problems with laboratory tests or conferred with physicians or others requesting laboratory services;
- were partially or wholly responsible for decisions about procurement of laboratory equipment, reagents, etc.;
- felt that their duties and responsibilities were not clearly defined by their immediate supervisors.

Significantly more of the medical technologists employed in laboratories in hospitals with more than 400 beds

- held bachelor's degrees;
- were specialists (i.e., worked only in one field of medical technology);
- held non-supervisory positions;
- had teaching responsibilities;
- did not freely discuss problems with laboratory tests or confer with physicians or others requesting laboratory services;
- were satisfied that their duties and responsibilities had been clearly defined by their immediate supervisors.

Significantly more of the medical technologists employed in non-hospital laboratories

- held bachelor's degrees;
- worked as generalists;
- worked under laboratory directors who are not pathologists;
- were engaged in research;
- worked daytime hours only;
- were partially or wholly responsible for decisions about procurement of laboratory equipment, reagents, etc.;
- were satisfied that their duties and responsibilities were clearly defined by their immediate supervisors.

DISTINCTIONS PERTAINING TO GENERALISTS AND SPECIALISTS

The following statements summarize the distinctions attributable to generalists and specialists identified in this study. In general, these distinctions reflect the nature of the specialties indicated and would not constitute unusual findings.

Significantly more of the medical technologists employed as generalists (i.e., in more than one field)

- worked under part-time or consultant laboratory directors;
- did not have teaching responsibilities;
- were partially or wholly responsible for decisions about procurement of laboratory equipment, reagents, etc.;
- used commercially available pools in quality control;
- used three or four of the listed quality control measures in their work.

Significantly more of the medical technologists specializing in hematology

- worked a combined schedule of day, night and weekend hours;
- did not freely discuss problems with laboratory tests or confer with physicians or others requesting laboratory services;
- used duplicates of unknowns in quality control;
- used two of the listed quality control measures in their work.

Significantly more of the medical technologist specializing in chemistry

- did not have teaching responsibilities;
- did not freely discuss problems with laboratory tests or confer with physicians or others requesting laboratory services;
- listed laboratory determinations learned in their work but not as students;
- used commercially available pools in quality control;
- used standard solutions of known concentration in quality control;
- used all six listed quality control measures in their work.

Significantly more of the medical technologists specializing in microbiology

- had teaching responsibilities;
- freely discussed problems with laboratory tests or conferred with physicians or others requesting laboratory services;
- were partially or wholly responsible for decisions about procurement of laboratory equipment, reagents, etc.;
- listed laboratory determinations learned in their work but not as students;
- used known positive samples in quality control;
- did not use any of the listed quality control measures.

Significantly more of the medical technologists specializing in blood bank

- worked under part-time or consultant laboratory directors;
- used known positive samples in quality control;
- did not use any of the listed quality control measures in their work.

TABLE 7

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists.	271	205	57	98	50	66
PERCENT of Medical Technologists with the following characteristics:	%	%	%	%	%	%
Education level[a]						
Without degree: 3 years pre-clinical study . .	13	15	21[j]	14	10	8
With degree: 3 years pre-clinical study . .	62	62	65	53	76[j]	62[j]
With degree: 4 years pre-clinical study . .	25	23	14	33	14	30
Clinical study and job						
Not in same state. . . .	38					
In same state.	62					
California	10					
Illinois	8					
Michigan	7					
All others[b].	37					
Laboratory Director						
Time Basis: Full. . . .	68	68	51	74	76	65
Part. . . .	5	5	14[j]	1	2	6
Consultant.	5	5	12[j]	1	2	6
No reply. .	22	22	23	24	20	23
Title: No reply	2	X[c]	0	0	2	5
No Director. . . .	X[c]	0	0	0	0	3
Other than M.D.. .	5	2	4	1	2	15
M.D. other than Pathologist. . .	12	5	7	3	8	33
Pathologist. . . .	80	92	89	96	88	44[j]
Full Time. . . .	55					
Part Time or Consultant . .	7					
No reply	18					
Fields of Medical Technology						
Several.	45	42	67[j]	38	22	63[j]
Single	55	58	33	62	78	37
Chemistry.	21	22	19	22	26	15
Microbiology	13	12	9	11	18	11
Hematology	11	13	2	15	22	3
Blood Bank	7	9	2	11	12	2
Other[d].	3	2	1	3	0	6

TABLE 7

EMPLOYMENT CHARACTERISTICS
FOR
MEDICAL TECHNOLOGISTS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists	271	205	57	98	50	66
PERCENT of Medical Technologists with the following characteristics: (Cont'd)	%	%	%	%	%	%
Position Title & Teaching Duties						
All Medical Technologists	100	100	100	100	100	100
Teaching	38	47	38	47[j]	54[j]	14
Not teaching	62	53	62	53	46	86
Staff Medical Technologist	67	72	60	74	80[j]	52
Teaching	20					
Not teaching	47					
Supervisor[e]	24	25	38[j]	22	16	20
Teaching[f]	16					
Not teaching	8					
Research	9	3	2	4	4	29[j]
Teaching	2					
Not teaching	7					
Time Basis						
Full Time Hours	87	85	86	85	86	91
Day-Time	37	27	18	29	36	65[j]
Day, Weekend &/or Night	46	55	60[j]	54	50	20
Night, Relief, or Weekend	4	3	8	2	0	6
Part Time Hours	12	14	14	15	12	6
Day-Time	4	5	7	3	8	1
Relief or Weekend	8	9	7	12	4	5
Length of Employment						
In laboratory named						
12 months or less	27	24	23	26	24	35
13 through 24 months	25	24	24	26	20	29
25 through 36 months	41	44	51	39	48	29
More than 36 months	7	7	2	10	8	8
In present position						
12 months or less	37	35	35	36	32	42
13 through 24 months	28	27	26	29	24	30
25 through 36 months	33	36	39	32	40	24
More than 36 months	2	2	0	2	4	0

TABLE 7

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists	271	205	57	98	50	66
PERCENT of Medical Technologists with the following characteristics: (Cont'd)	%	%	%	%	%	%
Consult supervisor about laboratory problems						
No reply.	5	3	0	5	4	12
Never	2	1	0	3	0	4
Yes	93	96	100	92	96	84
Daily	38	40	40	33	52	32
Weekly	28	29	32	32	20	26
Monthly or seldom . . .	27	27	28	27	24	26
Discuss problems with laboratory tests with those who requested them						
No reply.	X[c]	0	0	1	0	2
No.	22	25	9	35[j]	24	15
Yes	77	75	91[j]	64	76	83
Make decisions about purchase of equipment, etc.						
No reply.	X[c]	0	0	0	0	2
No.	25	28	11	36	30	20
Yes	74	72	89[j]	64	70	78[j]
Assist	63	63	68	61	62	61
Complete responsibility	11	9	21	3	8	17
Duties and responsibilities defined by supervisor						
No reply	1	0	0	0	0	5
No.	22	24	30[j]	29[j]	10	15
Yes	77	76	70	71	90[j]	80[j]
Given responsibility to use independent judgment in performance of duties						
No reply.	X[c]	X[c]	2	0	0	2
No.	8	8	5	13	2	6
Yes	92	91	93	87	98	91

TABLE 7

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists	271	205	57	98	50	66
PERCENT of Medical Technologists with the following characteristics: (Cont'd)	%	%	%	%	%	%
Attend Continuing Education Programs						
Graduate School						
No reply.	88	89	89	88	90	86
No.	0	0	0	0	0	0
Yes	12	11	11	12	10	14
Professional Organization Meetings						
No reply.	55	56	51	62	48	55
No.	5	5	9	3	6	4
Yes	40	39	40	35	46	41
Seminars						
No reply.	65	65	58	67	70	64
No.	5	5	9	3	4	4
Yes	30	30	33	30	26	32
Workshops						
No reply.	64	62	54	61	74	68
No.	5	5	9	4	4	6
Yes	31	32	37	35	22	26
Other[9]						
No reply.	66	67	63	70	66	62
No.	5	5	9	4	4	5
Yes	29	27	28	26	30	33
Listed laboratory tests learned as students that are not done on their jobs						
No reply.	16	17	7	21	20	12
None.	10	11	11	12	8	9
Listed.	74	72	82	67	72	79

TABLE 7

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists.	271	205	57	98	50	66
PERCENT of Medical Technolgists with the following characteristics: (Cont'd)	%	%	%	%	%	%
Listed laboratory tests learned on their jobs that were not learned as students						
No reply	8	8	9	8	8	8
None.	6	6	7	7	2	6
Listed	86	86	84	85	90	86
Attitude about education						
Preparation adequate						
No reply.	X[c]	X[c]	0	0	2	1
No	18	17	19	17	14	20
Yes	81	82	81	83	84	79
Comments about needs[h]						
No comment.	71	75	67	78	78	62
Stated needs.	29	25	33	22	22	38
Use of quality control measures						
Type[i]: Pooled sample	44	45	33	55	38	39
Commercially available pool.	75	75	93	72	58	76
Standard solutions of known concentration .	68	67	81	63	60	71
Recovery solution . .	7	6	4	6	8	11
Duplicate of unknown	33	33	32	30	40	33
Known positive sample	51	50	63	44	46	53
Number: 0 measures	7	6	0	7	10	10
1 measure	15	15	10	14	22	14
2 measures	21	23	21	29	16	15
3 measures	22	23	32	18	22	20
4 measures	18	18	23	14	18	20
5 measures	14	12	14	14	6	20
6 measures	3	3	0	3	6	1

TABLE 7

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospital
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of Medical Technologists	271	205	57	98	50	66
PERCENT of Medical Technologists with the following characteristics: (Cont'd)	%	%	%	%	%	%
Calculate mean, standard deviation and range of quality control sample						
When a student:						
No reply	X[c]	0	0	0	0	2
No	46	48	63	41	44	39
Once	28	29	18	30	38	27
More than once	26	23	19	29	18	32
On present job:						
No reply	0	0	0	0	0	0
No	51	52	51	54	48	50
Once	9	10	12	9	12	5
More than once	40	38	37	37	40	45
Maintain and use quality control value charts						
When a student:						
No reply	X[c]	0	0	2	0	0
No	48	52	56	47	52	38
Yes	52	48	44	51	48	62
On present job:						
No reply	2	0	0	2	0	6
No	43	43	37	44	46	44
Yes	55	57	63	54	54	50

a. All have one year of clinical study in addition to pre-clinical study to fulfill requirements.

b. Less than 7% in any one state. Distribution by place of employment not determined.

c. X = Less than 1%.

d. "Other" fields are histopathology, cytology, and urinalysis.

e. Includes positions of Chief Medical Technologist, Section Supervisor, and Teaching Supervisor.

f. Includes 6% (15) who have title of Teaching Supervisor.

g. "Other" continuing education includes lectures, inservice education, etc.

Footnotes for Table 7
(continued)

h. Comments were made by those who think their education is adequate as well as by those who think it is not.

i. Percent for each type of quality control measure is percent of medical technologists replying that they use each measure. The percents of "No replies" are not given but can be determined by taking the difference between the given percent and 100%.

j. Calculations of chi^2 distribution shows that this figure is statistically significant in that the frequency exceeds the level of 0.05 probability.

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS

Item	Total in Study	Specialists						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Technologists.	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics	%	%	%	%	%	%	%	%
Education level[a]								
Without degree: 3 yrs. pre-clinical study .	13	9	3	9	12	15	12	19
With degree: 3 yrs. pre-clinical study . . .	63	71	78	68	70	75	62	51
4 yrs. pre-clinical study . . .	25	19	19	23	18	10	25	30
Laboratory Director								
Time basis: Full . . .	68	71	81	70	82	45	63	63
Part . . .	5	3	0	7	0	0	0	8[h]
Consultant	5	3	0	0	0	20[h]	0	7[h]
No reply .	22	23	19	23	18	35	37	22
Title: No reply. . . .	2	0	0	0	0	0	0	2
No Director . .	X[b]	1	0	0	0	5	0	X[b]
Other than M.D.	5	6	6	7	9	5	0	5
M.D. other than Pathologist .	12	9	10	9	9	5	12	16
Pathologist . .	80	84	84	84	82	85	88	76
Full Time . .	55							
Part Time or Consultant	7							
No reply . .	18							
Position Title & Teaching Duties								
All Med. Tech.	100	100	100	100	100	100	100	100
Teaching	38	48	52	33[h]	67[h]	60	12	27[h]
Not Teaching . . .	62	52	48	67	33	40	88	73
Staff Med. Tech. . .	67	62	71	70	58	45	50	72
Teaching	20							
Not Teaching . . .	47							
Supervisor[c].	24	26	23	19	24	50	38	21
Teaching[d]	16[h]							
Not Teaching . . .	8							
Research	9	12	6	11	18	5	12	7
Teaching	2							
Not Teaching . . .	7							

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS
(continued)

Item	Total in Study	Specialists						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Technologists	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Time Basis								
Full Time Hours	87	91	90	88	97	90	100	81
Day -time	37	38	22	40	42	30	88[h]	34
Day, Weekend, and/or Night	46	52	68[h]	48	55	55	12	39
Night, Relief, and/or Weekend	4	1	0	0	0	5	0	8
Part Time Hours	12	8	10	11	3	10	0	17
Day-time	4	5	7	7	0	5	0	4
Relief or Weekend	8	3	3	4	3	5	0	13
Length of employment								
In laboratory named								
12 months or less	27	30	23	35	27	35	25	23
13 through 24 months	25	19	19	18	15	20	38	32
25 through 36 months	41	41	42	40	49	35	25	40
More than 36 months	7	10	16	7	9	10	12	4
In present position								
12 months or less	37	40	45	42	33	35	38	33
13 through 24 months	28	23	16	19	24	45	25	33
25 through 36 months	33	34	36	32	42	20	37	32
More than 36 months	2	2	3	4	0	0	0	1
Consult supervisor about lab problems								
No reply	5	3	2	2	2	0	0	9
Never	2	1	0	2	3	0	0	3
Yes	93	96	98	97	90	100	100	89
Daily	38	39	52	32	42	30	50	36
Weekly	28	36	23	40	36	35	50	19
Monthly or seldom	27	21	23	25	12	35	0	33
Discuss problems with lab tests with those who requested them								
No reply	x[b]	0	0	0	0	0	0	2
No	22	25	35[h]	35[h]	3	15	25	20
Yes	77	75	65	65	97[h]	85	75	79

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS
(continued)

Item	Total in Study	Specialists						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Technologists.	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Make decisions about purchase of equipment, etc.								
No reply	X[b]	X[b]	0	2	0	0	0	X[b]
No	25	24	39	26	6	20	38	27
Yes	74	75	61	72	94[h]	80	62	72[h]
Assist	63	70	58	68	88	75	37	54
Complete responsibility.	11	5	3	4	6	5	25	18
Duties and responsibilities defined by supervisor								
No reply	1	0	0	0	0	0	0	2
No	22	20	32	25	9	15	0	25
Yes	77	80	68	75	91	85	100	73
Given responsibility to use independent judgment in performance of duties								
No reply	X[b]	0	0	0	0	0	0	X[b]
No	8	8	16	7	3	10	0	8
Yes	92	92	84	93	97	90	100	91
Attend continuing education programs								
Graduate School								
No reply	88	86	81	95	79	75	100	91
No	0	0	0	0	0	0	0	0
Yes	12	14	19	5	21	25	0	9
Prof. organization mtgs								
No reply	55	58	58	61	58	50	50	53
No	5	6	6	7	6	5	0	4
Yes	40	36	36	32	36	45	50	43
Seminars								
No reply	65	62	68	63	45	80	63	68
No	5	5	6	7	6	0	0	4
Yes	30	32	26	30	48	20	37	28

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS
(continued)

Item	Total in Study	Specialists						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Technologists	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Attend continuing education programs (continued)								
Workshops								
No reply	64	61	58	60	64	55	88	67
No	5	6	10	7	6	0	0	5
Yes	31	32	32	33	30	45	12	28
Other[e]								
No reply	66	67	71	67	64	60	75	66
No	5	5	6	7	6	0	0	5
Yes	29	28	23	26	30	40	25	29
Listed lab. tests learned on their jobs that were not learned as students								
No reply	8	6	10	4	0	10	25	11
None	6	3	3	4	3	0	13	17
Listed	86	91	87	93[h]	97[h]	90	62	81[h]
Listed lab. tests learned as students that are not done on their jobs								
No reply	16	17	13	18	15	25	37	13
None	10	9	10	7	15	5	13	11
Listed	74	73	77	75	70	70	50	75
Attitude about education								
Preparation adequate								
No reply	X[c]	X[c]	0	0	0	5	0	X[c]
No	18	17	10	14	18	25	37	19
Yes	81	83	90	86	82	70	63	80
Comments about needs[f]								
No comment	71	73	81	74	70	70	63	69
Stated needs	29	27	19	26	30	30	37	31

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS
(continued)

Item	Total in Study	Specialists						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Technologists	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Use of quality control measures								
Types[g]: Pooled Sample.	44	42	42	47	36	45	12	40
Commercially available pool	75	64	58	91[h]	39[h]	45	38	78[h]
Standard solution . .	68	61	65	84[h]	49[h,i]	25	25	67
Recovery solution . .	7	11	3	18	9[i]	5	12	2
Duplicate (unknown) . .	33	36	48[h]	37	36	20	12	25[h]
Known positive sample. . .	51	48	39	39[h]	70[h]	60[j]	25	48
Number: 0 measures . .	7	12	6	1	16[h]	20[h]	64[h]	15
1 measure. . .	15	14	19	7	18	20	12	14
2 measures . .	21	25	29[h]	30	15	30	0	13
3 measures . .	22	17	13	25	18	5	12	25[h]
4 measures . .	18	15	23	12	21	5	0	18[h]
5 measures . .	14	13	10	18	12	15	0	14
6 measures . .	3	4	0	7[h]	0	5	12	1
Calculate mean, standard deviation and range of quality control sample								
When a student								
No reply	X[b]	0	0	0	0	0	0	X[b]
No.	46	48	32	58	42	40	75	44
Once	28	27	45	18	24	35	13	30
More than once . . .	26	26	23	25	33	25	12	25
On present job								
No reply.	0	0	0	0	0	0	0	0
No	51	54	48	37	73	65	88	48
Once	9	9	13	9	6	10	0	10
More than once . . .	40	38	39	54	21	25	12	42

TABLE 8

EMPLOYMENT CHARACTERISTICS
For
MEDICAL TECHNOLOGISTS
As
GENERALISTS AND SPECIALISTS
(continued)

Item	Total in Study	Specialist						Generalists
		Specialists (All)	Hematology	Chemistry	Microbiology	Blood Bank	Histo., Cyto., Urinal.	
Number of Medical Tecnologists.	271	149	31	57	33	20	8	122
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Maintain & use quality contol value charts								
When a student								
No reply	X[b]	X[b]	0	0	3	0	0	0
No	48	50	55	58	33	35	75	46
Yes.	52	50	45	42	64	65	25	54
On present job								
No reply	2	3	0	0	6	5	25	0
No	43	46	48	26	61	65	75	38
Yes.	55	50	52	74	33	30	0	61

a. All have one year of clinical study in addition to pre-clinical study to fulfill requirements.

b. X = Less than 1%

c. Includes positions of Chief Medical Technologist, Section Supervisor, and Teaching Supervisor.

d. Includes 6% (15) who have title of Teaching Supervisor.

e. "Other" continuing education includes lectures, inservice education, etc.

f. Comments were made by those who think their education is adequate as well as by those who think it is not.

g. Percent for each type is the percent of medical technologists replying that they use each measure. The percents of "No replies" are not given but can be determined by taking the difference between the given percent and 100%.

h. Calculation of chi^2 distribution shows that this figure is statistically significant in that the frequency exceeds the level of 0.05 probability.

i. This category is applicable to other specialties, but not to microbiology.

TABLE 9

EMPLOYMENT CHARACTERISTICS FOR MEDICAL TECHNOLOGISTS ACCORDING TO USE OF QUALITY CONTROL MEASURES

Item	Total in Study	Number of Quality Control Measures Used						
		0	1	2	3	4	5	6
Number of Medical Technologists	271	19	40	58	60	49	38	7
PERCENT of medical technologists with the following characteristics	%	%	%	%	%	%	%	%
Laboratory Director								
Time Basis: Full	68	58	62	72	70	63	74	57
Part	5	5	5	2	7	10	3	0
Consultant . . .	5	5	0	9	6	2	5	0
No reply	22	32	33	17	17	25	18	43
Title: No reply.	2	0	5	0	1	2	0	0
No director	X[a]	0	0	2	0	2	0	0
Other than M.D. . . .	5	16	0	5	7	4	5	0
M.D. other than Path.	12	16	17	14	2	16	13	14
Pathologist	80	68	78	79	90	76	82	86
Full Time	55							
Part Time/Consultant	7							
No reply.	18							
Fields of medical technology								
Several.	45	11	47	36	57[c]	55[c]	47	14
Single	55	89	53	64	42	44	53	86
Chemistry	21	5	10	29	23	14	26	57[c]
Microbiology	13	26[c]	15	9	10	14	11	0
Hematology	11	11	15	16[c]	7	14	8	0
Blood Bank	7	21[c]	10	10	1	2	8	15
Other[b]	2	26[c]	3	0	1	0	0	14
Position Title & Teaching Duties								
All med. technologists . . .	100	100	100	100	100	100	100	100
Teaching	38	26	30	41	38	37	50	43
Not Teaching	62	74	70	59	62	63	50	57
Staff med. technologists . .	67	47	70	66	70	71	58	100
Teaching	20							
Not Teaching	47							
Supervisor[d]	24	37	18	29	22	24	32	0
Teaching[e].	16							
Not Teaching	8							
Research	9	16	12	3	8	4	10	0
Teaching	2							
Not Teaching	7							

TABLE 9

EMPLOYMENT CHARACTERISTICS FOR MEDICAL TECHNOLOGISTS ACCORDING TO USE OF QUALITY CONTROL MEASURES (continued)

Item	Total in Study	Number of Quality Control Measures Used						
		0	1	2	3	4	5	6
Number of Medical Technologists	271	19	40	58	60	49	38	7
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Time Basis								
Full Time Hours	87	74	75	92	92	88	82	86
Day-time	37	58	30	35	32	37	40	57
Day, Weekend, &/or Night	46	11	45	55	57	47	34	29
Night, Relief, or Weekend	4	5	0	2	3	4	8	0
Part Time Hours	12	21	14	6	7	12	18	14
Day-time	4	5	5	2	2	6	10	0
Relief or Weekend	8	16	10	4	5	6	8	14
Consult supervisor about laboratory problems								
No reply	5	11	7	3	3	10	3	0
Never	2	0	0	9	0	2	0	0
Yes	93	89	93	87	96	88	97	99
Daily	38	37	30	27	38	45	45	71
Weekly	28	26	30	36	28	20	26	14
Monthly or seldom	27	26	33	24	30	23	26	14
Discuss problems with lab. tests with those who requested them								
No reply	x^a	0	3	2	0	0	0	0
No	22	21	17	31	18	18	29	14
Yes	77	79	80	67	82	82	71	86
Make decisions about purchase of equipment, etc.								
No reply	x^a	0	2	0	0	0	3	0
No	25	32	25	19	25	29	29	29
Yes	74	68	73	81	75	71	68	71
Assist	63	58	63	69	68	57	55	57
Complete responsibility	11	10	10	12	7	14	13	14
Duties and responsibilities defined by supervisor								
No reply	1	0	5	0	0	2	0	0
No	22	21	25	33	25	14	10	14
Yes	77	79	70	67	75	84	90	86

TABLE 9

EMPLOYMENT CHARACTERISTICS FOR MEDICAL TECHNOLOGISTS ACCORDING TO USE OF QUALITY CONTROL MEASURES
(continued)

Item	Total in Study	Number of Quality Control Measures Used						
		0	1	2	3	4	5	6
Number of Medical Technologists	271	19	40	58	60	49	38	7
PERCENT of medical technologists with the following characteristics (Cont'd)	%	%	%	%	%	%	%	%
Given responsibility to use independent judgment in performance of duties								
No reply	X[a]	0	2	2	0	0	0	0
No	8	10	15	8	3	6	8	0
Yes	92	90	83	90	97	94	92	100
Attitude about education								
Preparation adequate								
No reply	X[a]	5	2	0	0	0	0	0
No	18	32	23	17	15	14	16	14
Yes	81	63	75	83	85	86	84	86
Calculate mean, standard deviation & range of quality control sample								
When a student								
No reply	X[a]	0	0	0	0	2	0	0
No	46	58	42	45	50	45	39	43
Once	28	16	40	31	23	31	29	0
More than once	26	26	18	24	27	22	32	57
On present job								
No reply	0	0	0	0	0	0	0	0
No	51	89	50	52	55	51	32	29
Once	9	0	7	8	8	10	16	14
More than once	40	11	43	40	37	39	52	57
Maintain & use quality control value charts								
When a student								
No reply	X[a]	0	3	0	0	0	0	0
No	48	47	37	59	50	49	42	28
Yes	52	53	60	41	50	51	58	72
On present job								
No reply	2	16	5	1	0	0	0	0
No	43	73	50	49	40	41	18	43
Yes	55	11	45	50	60	59	82	57

Footnotes for Table 9

a. X = Less than 1%.

b. "Other" fields are histopathology, cytology, and urinalysis.

c. Calculation of chi square distribution shows that this figure is statistically significant in that the frequency exceeds the level of 0.05 probability.

d. Includes positions of Chief Medical Technologist, Section Supervisor, and Teaching Supervisor.

e. Includes 6% (15) who have title of Teaching Supervisor.

F. CHARACTERISTICS OF LABORATORY SUPERVISORS

Each of the medical technologists in this survey was asked to state the name, address and title of his immediate supervisor. Of the 271 polled, 254 did so. Two sets of questionnaires were sent to the supervisors identified, 193 of whom returned data. Replies to the questionnaire relating to these supervisors are summarized in Table 10.

One-fourth of the responding supervisors were laboratory directors including 14% who were pathologists. Sixty-one percent of the responding supervisors were medical technologists (ASCP) with titles equivalent to chief medical technologist, section supervisor or teaching supervisor. Thirteen percent were laboratory or section supervisors who were neither physicians nor technologists but had completed training ranging from doctorate in specialties to Registered Nurse. In general, more of the pathologists were in non-hospital laboratories; more chief medical technologists were employed in hospitals with fewer than 400 beds; and more section supervisors were employed in hospitals with more than 400 beds.1/

Eighty percent of the responding supervisors held academic degrees: 46% of them Bachelor's, 20% M.D.'s, and 14% Master's or other Doctorates. Significantly more M.D.'s worked in non-hospital laboratories and more supervisors with bachelor's degrees worked in hospitals with more than 200 beds.2/ Eighty-one percent of the supervisors had formal education in medical technology. There is no significant difference in the distribution of these replies according to the location of laboratories.3/

The supervisors ranged in age from 24 through 77 years, 45% being between 36 and 45. Half of them have worked in medical laboratories longer than ten years and 81% have been employed from two through 40 years. There is no significant difference in this distribution on the basis of laboratory location.4/ Fifty-five percent had held their current positions five years or less. This group is characteristic of supervisors in larger hospitals (more than 400 beds), whereas significantly more of those holding positions for six through ten years were in hospitals with 200 through 399 beds, and more of those holding their current positions longer than 15 years were in smaller hospitals (fewer than 200 beds).5/

Supervisors were asked to indicate the number of personnel they supervised. Almost all (96%) reported that they supervised from one through 73 technical personnel including 40% who were responsible for ten or fewer personnel and 56% for more than ten. Significantly more of the supervisors responsible for fewer than 11 personnel were in non-hospital laboratories, while more of those responsible for more than 20 personnel were in hospitals with more than 200 beds.6/

Seventy percent of the supervisors directed one through ten clerical personnel and 54% directed one through ten maintenance personnel. There is no significant difference in the distribution of these replies.7/

Eighty-seven percent of the supervisors belong to professional organizations. Those holding membership in only one or two (55%) tended to be employed in hospitals with more than 200 beds, whereas those holding membership in three or more tended to work in non-hospital laboratories.8/

1/ $X^2 = 54.15$; df = 12, $X^2 = 21.03$
2/ $X^2 = 26.55$; df = 6, $X^2 = 12.59$
3/ $X^2 = 6.09$; df = 3, $X^2 = 7.81$
4/ $X^2 = 2.36$; df = 9, $X^2 = 16.92$
5/ $X^2 = 17.02$; df = 9, $X^2 = 16.92$
6/ $X^2 = 22.84$; df = 6, $X^2 = 12.59$
7/ $X^2 = 0.63$; df = 3, $X^2 = 7.81$
8/ $X^2 = 10.26$; df = 3, $X^2 = 7.81$

In regard to continuing education, 9% of the supervisors were attending graduate school, 55% attended seminars and workshops and 76% attended meetings of professional organizations. There is no significant difference in the distribution of these replies.9/

Forty percent indicated one through four periodicals currently used in their work and 40% listed five through eight textbooks in regular use.

SUMMARY
of
Characteristics of Laboratory Supervisors

Significantly more of the laboratory supervisors in hospitals with fewer than 200 beds

- were chief medical technologists certified as M.T.(ASCP);
- have held their positions for more than 15 years.

Significantly more of the laboratory supervisors in hospitals with more than 200 beds

- were section supervisors certified as M.T.(ASCP);
- held bachelor's degrees;
- had held their current positions longer than five years;
- supervised more than 20 technical personnel;
- held membership in one or two professional organizations.

Significantly more of the laboratory supervisors in hospitals with more than 400 beds

- were section supervisors certified as M.T.(ASCP);
- held bachelor's degrees;
- had held their current positions five years or less;
- supervised more than 20 technical personnel.

Significantly more of the laboratory supervisors in non-hospital laboratories

- were pathologists;
- held medical degrees;
- supervised fewer than 11 technical personnel;
- held membership in three or more professional organizations.

9/ $X^2 = 1.03$; df = 6, $X^2 = 12.59$

TABLE 10

CHARACTERISTICS
For
LABORATORY SUPERVISORS

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospitals
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of laboratory supervisors	193	149	35	70	44	44
PERCENT of laboratory supervisors with the following characteristics	%	%	%	%	%	%
Position Title						
No reply	0	0	0	0	0	0
Laboratory Director	25	14	26	10	13	57
M.D.: Pathologist	14	9	14	6	11	30[a]
M.D.: Not Pathologist	7	4	9	4	0	16
Not M.D.	4	1	3	0	2	11
Supervisor	74	85	74	90	86	43
M.T.(ASCP): Chief Medical Technologist	32	38	51[a]	41[a]	20	14
M.T.(ASCP): Section Supervisor	21	24	3	26	39[a]	11
M.T.(ASCP): Teaching Supervisor	8	10	0	16	9	0
Not M.T.(ASCP) nor M.D.	13	13	20	7	18	18
Supervisor in single field						
No reply	74	73	97	72	54	87
Field:	26	27	3	28	46	13
Blood Bank	5	6	3	4	11	0
Chemistry	10	11	0	16	14	5
Hematology	4	4	0	4	7	3
Microbiology	7	6	0	4	14	5
Education						
No reply	5	7	11	7	5	11
No degree	15	14	14	17	9	7
Degree	80	78	74	75	86	82
M.D.	20	13	20	10	11	45[a]
Master's or doctorate	14	13	11	11	18	14
Bachelor's	46	52	43	54[a]	57[a]	23
Personnel supervised						
Technical						
No reply	4	6	29	0	0	12
1 through 10	40	33	37	30	34	61[a]
11 through 20	25	27	20	33	23	20
21 or more[b]	31	34	14	37[a]	43[a]	7
Clerical						
No reply	26	27	31	29	23	39
1 through 10	70	70	69	70	70	59
11 through 20	2	2	0	1	5	2
21 or more[c]	2	1	0	0	2	0

TABLE 10

CHARACTERISTICS
For
LABORATORY SUPERVISORS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospitals
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of laboratory supervisors	193	149	35	70	44	44
PERCENT of laboratory supervisors with the following characteristics (continued)	%	%	%	%	%	%
Personnel supervised (continued)						
Maintenance						
No reply.	45	43	46	39	50	61
1 through 10.	54	56	54	60	50	39
11 through 20	1	1	0	1	0	0
21 or more[d]	0	0	0	0	0	0
Professional organization						
No reply.	13	7	9	10	2	25
Belong to 1 or 2.	55	69	57	73[a]	73[a]	39
Belong to 3 or more	32	24	34	17	25	36[a]
Formal education in medical technology						
No reply	7	7	11	7	4	11
No.	12	9	12	4	14	18
Yes	81	84	77	89	82	70
Age Groups						
No reply	4	1	3	1	0	10
24 through 35 years	35	38	29	43	36	27
36 through 45 years	45	45	51	39	50	43
46 through 77 years	16	16	17	17	14	20
Length of employment						
Total years						
No reply.	19	11	26	6	11	37
2 through 5 years	10	12	11	11	14	7
6 through 10 years	21	21	14	24	20	20
11 through 15 years	24	26	20	29	25	20
16 or more years[f]	26	30	29	30	30	16
Present position						
No reply	4	3	3	3	5	14
1 through 5 years	55	56	46	56	66[a]	45
6 through 10 years	25	25	26	34[a]	9	25
11 through 15 years	9	9	11	6	11	11
16 or more years[g]	7	7	14[a]	1	9	5

TABLE 10

CHARACTERISTICS
For
LABORATORY SUPERVISORS
(continued)

Item	Total in Study	Employed in Hospitals				Employed Outside of Hospitals
		All Hospitals	Fewer than 200 Beds	200-399 Beds	400 or More Beds	
Number of laboratory supervisors	193	149	35	70	44	44
PERCENT of laboratory supervisors with the following characteristics (continued)	%	%	%	%	%	%
Attend continuing education programs						
Graduate School						
No reply	91	91	86	93	91	93
Yes	9	9	14	7	9	7
Seminars and/or workshops						
No reply	45	42	34	40	50	55
Yes	55	58	66	60	50	45
Professional organization meetings						
No reply	24	21	11	23	25	36
Yes.	76	79	89	77	75	64
Periodicals used currently						
No reply	6	8	8	7	9	14
1 through 4	40	38	40	39	36	34
5 through 8	35	31	26	37	25	32
9 or more[h]	19	23	26	17	30	20
Textbooks used currently						
No reply	9	4	20	0	0	75
1 through 4	32	32	17	40	30	20
5 through 8	40	48	43	47	52	25
9 or more[i]	19	16	20	13	18	30

a. Calculation of chi square distribution shows that this figure is statistically significant in that the frequency exceeds the level of 0.05 probability.

b. The largest number of technical personnel supervised is 73.

c. The largest number of clerical personnel supervised is 35.

d. The largest number of maintenance personnel supervised is 12.

e. The largest number of professional organizations listed is 9.

f. The longest period of employment is 40 years.

g. The longest period of employment in a position is 37 years.

h. The largest number of periodicals listed is 18.

i. The largest number of textbooks listed is 17.

G. JOB PERFORMANCE RATING

The second questionnaire returned by the 193 supervisors described in Section F contained ratings of job performance of their technologists. The ratings were given on 60 items defining aspects of job performance which were divided into five categories: Skills, Dependability, Reliability, Initiative, and Personal Relations. The form containing all 60 items is in the Appendix of this report.

The ratings, which were subjective, were based on a scale of "excellent", "good", "average", "less than average", "unsatisfactory", and "does not apply". The last is for items which may not apply to the duties performed by the technologists. Table 11 gives the distribution of ratings for 193 technologists, Table 12 for 175 technologists who passed the July 1962 certification examination, and Table 13 for 18 technologists who failed the examination.

The arithmetic mean of the number of people rated in each scale in all categories shows that 72 (37%) of the 193 technologists were rated "excellent", 66 (34%) "good", 36 (18%) "average", 7 (4%) "less than average", 1 (less than 1%) "unsatisfactory", and 9 (5%) "does not apply". In Tables 11, 12, and 13 all numbers are represented as percentages.

A comparison of the mean number for each category with that for all categories shows that significantly more technologists (160) (83%) were rated above "average" in Dependability and more (83) (43%) "average" or lower in Initiative.[1] Significantly more of those who passed the examination (83%) were rated above "average" in Dependability.[2] The distribution of ratings by category for those who failed the examination shows no significant difference.[3]

There is no significant difference in the distribution of ratings for those who passed the certification examination and those who failed when they are compared item for item.[4]

The distribution of job performance ratings for 25 items varied significantly; above "average" for 14 items, "average" or lower for eight items and "excellent" for three items. The significance is reported in the following paragraphs.

Above "Average" Ratings

The specific items in which significantly more of the 193 technologists were rated above "average" are listed below according to definitive reference. (Table 11)

Techniques
Skills item a. "Consistently uses good technique in performing laboratory tests." (88%)[5]
Skills item b. "Has good manual dexterity." (86%)[6]
Reliability item a. "Follows technical procedures as outlined in the laboratory using instructions as guides." (92%)[7]

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[1] The statistical significance of distributions of job performance ratings was determined by application of the Kolmogorov-Smirnov formula. This chi square distribution formula is used to determine whether or not two independent samples are from the same population with respect to a specific attribute.
X^2 = 8.82; df = 2, X^2 = 5.99 (Dependability)
X^2 = 9.70; df = 2, X^2 = 5.99 (Initiative)

[2] X^2 = 7.20; df = 2, X^2 = 5.99

[3] X^2 = 0.12 through 0.56 (range); df = 2, X^2 = 5.99

[4] X^2 = 0.05 through 2.94 (range); df = 2, X^2 = 5.99

[5] X^2 = 9.71; df = 2, X^2 = 5.99

[6] X^2 = 7.74; df = 2, X^2 = 5.99

[7] X^2 = 15.93; df = 2, X^2 = 5.99

Judgment

Reliability item f. "Voluntarily repeats tests giving illogical results without being asked to do so by the supervisor." (85%)8/

Personal Behavior

Reliability item b. "Abides by established personnel and other administrative policies." (86%)9/

Utilization of Time

Dependability item h. "Does not habitually ask others to complete or assist with completion of work assignments." (86%)10/

Dependability item i. "Will accept duties and instructions given by supervisors and will complete them without further reminder. (That is, requires a minimum of supervision)." (85%)11/

Attendance

Dependability item c. "Amount of sick leave taken has been minimal and justified." (87%)12/

Dependability item d. "Requests for annual leave (vacation) have been reasonable (within established policy) and considerate of the total staff." (80%)13/

Dependability item e. "Special requests of unplanned short absences have been minimal or non-existent. (Doctors', Dentists', or other special appointments)." (86%)14/

Dependability item f. "Gives notice of absence sufficiently in advance so that laboratory work schedule can be satisfactorily adjusted." (88%)15/

Dependability item g. "Remains on duty until all work assigned to her (him) is completed." (85%)16/

Supervisory Consultation

Dependability item j. "Consults supervisor about unusual problems and/or situations (technical and/or administrative) when necessary." (86%)17/

Appearance

Personal Relations item k. "Personal appearance is exemplary: Clean uniform and shoes, personally neat." (84%)18/

The distribution of ratings of the technologists who passed the certification examination compared with the mean of 60 items for 193 technologists shows that significantly more of them were rated above "average" in all items listed above. (Table 12)19/ The distribution of ratings of the technologists who passed compared with the mean for all items in their group (175 technologists) shows that significantly more were rated above "average" in the items listed above except Dependability item i and Reliability item f. (Table 12)20/

8/ X^2 = 6.18; df = 2, X^2 = 5.99
9/ X^2 = 7.74; df = 2, X^2 = 5.99
10/ X^2 = 17.20; df = 2, X^2 = 5.99
11/ X^2 = 7.09; df = 2, X^2 = 5.99
12/ X^2 = 22.60; df = 2, X^2 = 5.99
13/ X^2 = 9.08; df = 2, X^2 = 5.99
14/ X^2 = 11.07; df = 2, X^2 = 5.99
15/ X^2 = 22.19; df = 2, X^2 = 5.99
16/ X^2 = 23.55; df = 2, X^2 = 5.99
17/ X^2 = 10.42; df = 2, X^2 = 5.99
18/ X^2 = 7.10; df = 2, X^2 = 5.99
19/ X^2 = 6.58 through 20.02 (range); df = 2, X^2 = 5.99
20/ X^2 = 5.78; df = 2, X^2 = 5.99 (Dependability item i) and (Reliability item f)
X^2 = 6.16 through 19.21 (range); df = 2, X^2 = 5.99 (Other items)

When compared similarly with 193 technologists, significantly more of those who failed the examination were rated above "average" only in Dependability items c, e, f, and g. (Table 13)21/ Among the technologists who failed, there is no significant difference in the distribution of the ratings. (Table 13)22/

"Average" or Lower Ratings

The specific items in which significantly more of the 193 medical technologists were rated "average" or lower are listed below with definitive reference. (Table 11)23/

Instrumentation

Skills item g. "Makes or is able to make simple adjustments and repairs of electrical, mechanical and optical equipment without specific instructions from supervisor." (62%) (57%)24/

Quality Control

Skills item i. "Calculates or has demonstrated ability to calculate the mean, standard deviation and range values of quality control values (measures)." (53%) (26%)25/

Continuing Education

Initiative item e. "Reads publications pertaining to work. (Evident by conversation about publications and/or interest in introducing newly reported methods or modifications of existing methods, hints on improving techniques, etc.)." (54%) (52%)26/

Initiative item g. "Is a member of appropriate professional organization." (44%) (34%)27/

Initiative item h. "Shows desire to continue education by having attended local, regional and/or national educational meetings within the past 18 months." (60%) (48%)28/

Initiative item i. "Attends educational programs offered within the institution as work schedule and opportunity allow. (Such as in-service training sessions; Pathology Conferences; Medical, Surgical and Grand Rounds; guest lecturers, etc.)." (57%) (34%)29/

Initiative item j. "Reports, formally or informally, on attendance at educational meetings for the benefit of other members of the staff." (68%) (38%)30/.

Personal Relations

Initiative item k. "Constructively suggests modifications of administrative policies if occasion arises." (47%) (36%)31/

The distribution of ratings of the technologists who passed the certification examination compared with the mean of 60 items for 193 technologists shows that significantly more of them were rated "average" or lower in the items listed above except Initiative item k. (Table 12)32/ The distribution of ratings of the technologists who passed compared with the mean for all items in their group (175 technologists) shows that significantly more were rated "average" or lower in all items except Initiative item k. (Table 12)33/

21/ $X^2 = 6.76$; df = 2, $X^2 = 5.99$

22/ $X^2 = 0.02$ through 5.77 (range); df = 2, $X^2 = 5.99$

23/ Calculation of significant distributions included the numbers of technologists rated "does not apply". The first percentages include these numbers and the second exclude them.

24/ $X^2 = 48.68$; df = 2, $X^2 = 5.99$

25/ $X^2 = 25.21$; df = 2, $X^2 = 5.99$

26/ $X^2 = 26.34$; df = 2, $X^2 = 5.99$

27/ $X^2 = 16.95$; df = 2, $X^2 = 5.99$

28/ $X^2 = 48.97$; df = 2, $X^2 = 5.99$

29/ $X^2 = 31.83$; df = 2, $X^2 = 5.99$

30/ $X^2 = 60.80$; df = 2, $X^2 = 5.99$

31/ $X^2 = 15.81$; df = 2, $X^2 = 5.99$

32/ The significant distribution for Initiative item k shows that significantly fewer of the technologists in the "Pass" group were rated "excellent". $X^2 = 15.67$; df = 2, $X^2 = 5.99$
$X^2 = 15.15$ through 56.90 (range); df = 2, $X^2 = 5.99$ (Other items)

When compared similarly with 193 technologists, significantly more of those who failed the examination were rated "average" or lower in all items listed except Skills item i and Initiative items e and g. (Table 13)34/ Among the technologists who failed, there is no significant difference in the distribution of ratings. (Table 13)35/

"Excellent" Ratings

Significantly fewer of the 193 technologists were rated "excellent" in the items listed below with definitive reference. (Table 11)

Mathematics
Skills item n. "Understands the derivation of formulae (calculations) involving dilution factors, correction factors, etc. so that substitutions in formulae are made to account for unusual conditions of doing determinations." (20%)36/

Judgment
Reliability item d. "Makes decisions in complex as well as routine situations as necessary." (23%)37/

Work Accomplishment
Initiative item c. "Voluntarily does and reports additional laboratory work (even though it may not be requested) to prove or enhance laboratory findings when circumstances warrant." (25%)38/

The distribution of ratings of the technologists who passed the certification examination compared with the mean of 60 items for 193 technologists shows that significantly fewer of them were rated "excellent" in all items except Initiative item c. (Table 12)39/ The distribution of ratings of the technologists who passed compared with the mean for all items in their group (175 technologists) shows that significantly fewer were rated "excellent" in all items listed above except Initiative item c. (Table 12)40/

When compared similarly with 193 technologists and their own group (18 technologists), there is no significant difference in the rating distributions for these items. (Table 13)41/

33/ Significantly fewer were rated "excellent". $X^2 = 14.77$; df = 2, $X^2 = 5.99$
$X^2 = 11.46$ through 56.41 (range); df = 2, $X^2 = 5.99$

34/ $X^2 = 4.80$; df = 2, $X^2 = 5.99$ (Skills item i)
$X^2 = 5.12$; df = 2, $X^2 = 5.99$ (Initiative item e)
$X^2 = 4.51$; df = 2, $X^2 = 5.99$ (Initiative item g)

35/ $X^2 = 2.42$ through 5.01 (range); df = 2, $X^2 = 5.99$

36/ $X^2 = 11.28$; df = 2, $X^2 = 5.99$

37/ $X^2 = 8.16$; df = 2, $X^2 = 5.99$

38/ $X^2 = 6.30$; df = 2, $X^2 = 5.99$

39/ $X^2 = 5.81$; df = 2, $X^2 = 5.99$ (Initiative item c)
$X^2 = 7.45$ through 10.38 (range); df = 2, $X^2 = 5.99$ (Other items)

40/ $X^2 = 5.43$; df = 2, $X^2 = 5.99$ (Initiative item c)
$X^2 = 7.03$ through 14.77 (range); df = 2, $X^2 = 5.99$ (Other items)

41/ $X^2 = 3.97, 2.52, 1.26$; df = 2, $X^2 = 5.99$ (193 technologists)
$X^2 = 1.89, 1.95, 1.09$; df = 2, $X^2 = 5.99$ (18 technologists)

SUMMARY of Job Performance Rating

The summary of job performance ratings for 193 medical technologists shows that
37% were rated "excellent"
34% were rated "good"
18% were rated "average"
4% were rated "less than average"
less than 1% were rated "unsatisfactory" and
5% were rated "does not apply".

A comparison of the ratings summarized for each category of performance shows that

- significantly more of the 193 technologists were rated above "average" in Dependability and "average" or lower in Initiative;
- significantly more of the 175 technologists who passed the July 1962 certification examination were rated above "average" in Dependability; and
- there is no significant difference in the ratings for the technologists who failed the July 1962 certification examination.

There is no significant difference in the distribution of ratings for those who passed the July 1962 certification examination and those who failed it when they are compared item for item.

A comparison, item for item, shows that the ratings for the following 25 items vary from the norm for 60 items:

- significantly more of the 193 technologists were rated above "average" in
  - techniques as described in Skills items a and b, and Reliability item a
  - judgment as described in Reliability item f
  - personal behavior as described in Reliability item b
  - utilization of time as described in Dependability items h and i
  - attendance as described in Dependability items c, d, e, f, and g
  - appearance as described in Personal Relations item k
- significantly more of those who passed the July 1962 certification examination were rated above "average" in the items listed above
- significantly more of those who failed the July 1962 certification examination were rated above "average" only in Dependability items c, e, f, and g
- significantly more of the 193 technologists were rated "average" or lower in
  - instrumentation as described in Skills item g
  - quality control as described in Skills item i
  - continuing education as described in Initiative items e, g, h, i, and j
  - personal relations as described in Initiative item k
- significantly more of those who passed the July 1962 certification examination were rated "average" or lower in the items listed above except Initiative item k
- significantly more of those who failed the July 1962 certification examination were rated "average" or lower in the items listed above except Skills item i and Initiative items e and g

- significantly fewer of the 193 technologists were rated "excellent" in
  - mathematics as described in Skills item n
  - judgment as described in Reliability item d
  - work accomplishment as described in Initiative item c

- significantly fewer of the technologists who passed the July 1962 certification examination were rated "excellent" in the items listed above except Initiative item c

- there is no significant difference in the distribution of ratings for the items listed above for the technologists who failed the July 1962 certification examination.

TABLE 11

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS

Item	Total of 193 M. T.	No Reply	Job Performance Rating: Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
	%	%	%	%	%	%	%	%
PRECENT[a] rated for 60 items.	100	x[d]	37	34	18	4	x[d]	5
Each category of								
1. Skills								
19 items.	100	x[d]	33	38	19	3	x[d]	5
Each item[b] of								
a. Techniques.	100	0	39	49[c]	11	x[d]	0	0
b. Techniques.	100	0	40	46[c]	13	x[d]	0	0
c. Techniques.	100	0	39	41	18	2	0	0
e. Techniques.	100	0	31	41	24	3	0	2
f. Techniques.	100	0	33	39	24	2	0	3
d. Instrumentation	100	1	38	33	24	4	1	0
g. Instrumentation	100	2	14	22	39[c]	15	3	5
h. Quality Control	100	0	37	40	9	2	0	11
i. Quality Control	100	1	17	29	22[c]	3	1	27
m. Quality Control	100	x[d]	27	42	19	2	0	9
j. Judgment.	100	x[d]	42	42	11	3	x[d]	x[d]
k. Judgment.	100	0	39	36	15	2	x[d]	8
l. Judgment.	100	1	37	35	19	4	0	4
o. Judgment.	100	0	42	40	17	x[d]	0	0
p. Judgment.	100	x[d]	28	45	23	2	0	2
q. Judgment.	100	0	28	35	21	3	0	13
n. Mathematics	100	2	20[c]	37	28	4	1	8
r. Efficiency.	100	x[d]	39	39	17	4	0	0
s. Efficiency.	100	1	35	35	14	4	x[d]	9

TABLE 11

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS
(continued)

Item	Total of 193 M. T.	No Reply	Job Performance Rating					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT [a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
2. Dependability								
11 items.	100	x^d	53^c	30	12	3	x^d	1
Each item[b] of								
a. Utilization of time . .	100	x^d	43	28	19	7	2	0
h. Utilization of time . .	100	x^d	58^c	28	10	1	x^d	1
i. Utilization of time . .	100	x^d	50	35^c	12	2	x^d	0
k. Utilization of time . .	100	1	36	45	17	1	0	x^d
b. Attendance	100	x^d	43	25	19	5	x^d	6
c. Attendance	100	x^d	62^c	25	5	6	x^d	x^d
d. Attendance	100	x^d	53^c	27	11	2	1	6
e. Attendance	100	x^d	54^c	32	9	3	0	x^d
f. Attendance	100	1	62^c	26	9	0	1	1
g. Attendance	100	x^d	62^c	23	11	2	0	x^d
j. Consults supervisor . .	100	x^d	54^c	32	13	x^d	0	0
3. Reliability								
7 items	100	x^d	39	38	18	2	x^d	3
Each item[b] of								
a. Techniques	100	x^d	56	36^c	7	x^d	0	0
b. Personal	100	x^d	51	35^c	12	1	0	0
c. Judgment.	100	2	28	45	23	3	0	0
d. Judgment.	100	x^d	23^c	39	29	5	0	3
f. Judgment.	100	0	49	36^c	12	2	0	1
g. Judgment.	100	x^d	34	36	23	4	1	2
e. Quality Control	100	x^d	30	37	18	1	0	13

TABLE 11

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS
(continued)

Item	Total of 193 M. T.	No Reply	Job Performance Rating					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
4. Initiative								
12 items	100	2	26	29	24[c]	6	3	10
Each item[b] of								
a. Work accomplishment.	100	X[d]	37	31	22	8	1	X[d]
c. Work accomplishment.	100	0	25[c]	38	24	6	0	7
d. Work accomplishment.	100	0	40	34	22	3	0	1
f. Work accomplishment.	100	0	35	41	20	3	X[d]	1
e. Continuing education	100	0	17	29	40[c]	10	2	2
g. Continuing education	100	12	28	17	19[c]	6	9	10
h. Continuing education	100	5	18	17	26[c]	13	9	12
i. Continuing education	100	0	20	23	25[c]	6	3	23
j. Continuing education	100	1	10	22	28[c]	5	5	30
b. Personnel Relations.	100	X[d]	42	34	18	3	X[d]	2
k. Personnel Relations.	100	2	17	34	31[c]	4	1	11
l. Teaching[h].	100	2	30	31	12	4	X[d]	21
5. Personal Relations								
11 items	100	X[d]	41	35	17	3	X[d]	3
Each item[b] of								
a. Peers.	100	0	47	32	18	3	1	0
b. Peers.	100	X[d]	42	34	20	4	0	X[d]
g. Peers.	100	0	43	37	16	4	0	0
j. Peers.	100	0	36	38	19	1	0	6
c. Supervisors.	100	0	42	36	18	4	0	X[d]
e. Supervisors.	100	0	34	43	20	3	X[d]	0
d. Med. & Admin. Staff.	100	X[d]	35	36	19	4	0	5
h. Lab. Asst. & Non-technical	100	X[d]	37	33	13	3	X[d]	13
i. Lab. Asst. & Non-technical	100	0	38	41	18	2	0	X[d]
k. Personal Appearance.	100	0	51[c]	33	13	2	2	0
f. Patients	100	X[d]	47	27	11	3	0	11

Footnotes for Table 11

a. The "Total" is entered as 100% to indicate the direction of summation in this table. The actual sum of percentages varies from 99 through 101 because all are adjusted to the nearest whole number.

b. Letters preceding titles identify items in the rating form completed by the supervisor. The complete list of items is in the Appendix.

c. Comparison of item rating distribution for 193 technologists with means for ratings for all items for 193 technologists. Calculations of chi square distribution (Kolmogorov-Smirnov formula) show that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 63-66).

d. X = Less than 1%.

TABLE 12
JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS WHO PASSED THE CERTIFICATION EXAMINATION

Item	Total of 175 M. T.	No Reply	Job Performance Rating					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for	%	%	%	%	%	%	%	%
60 items	100	2	37	35	18	3	X[e]	5
Each category of								
1. Skills								
19 items	100	X[e]	33	39	19	3	X[e]	5
Each item[b] of								
a. Techniques	100	0	38	51[c,d]	10	X[e]	0	0
b. Techniques	100	0	41	46[c,d]	13	X[e]	0	0
c. Techniques	100	0	40	41	17	2	0	0
e. Techniques	100	0	31	42	23	2	0	1
f. Techniques	100	0	34	38	25	1	0	2
d. Instrumentation.	100	1	38	33	24	3	X[e]	0
g. Instrumentation.	100	2	14	22	39[c,d]	15	3	5
h. Quality Control.	100	0	37	42	7	2	0	11
i. Quality Control.	100	0	16	31	21[c,d]	3	1	27
m. Quality Control.	100	0	27	41	21	2	0	9
j. Judgment	100	0	42	42	11	3	X[e]	X[e]
k. Judgment	100	0	39	37	15	2	X[e]	7
l. Judgment	100	X[e]	36	35	20	4	0	4
o. Judgment	100	0	42	41	17	X[e]	0	0
p. Judgment	100	0	29	45	22	2	0	2
q. Judgment	100	0	29	34	21	3	0	13
n. Mathematics.	100	1	21[c,d]	38	28	3	1	8
r. Efficiency	100	1	21	38	28	3	1	8
s. Efficiency	100	X[e]	35	35	15	5	X[e]	10

TABLE 12
JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS
WHO PASSED THE CERTIFICATION EXAMINATION
(continued)

Item	Total of 175 M. T.	No Reply	Job Performance Rating					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
2. Dependability								
11 items	100	X[e]	52[c]	31	13	3	X[e]	1
Each item[b] of								
a. Utilization of time. .	100	0	43	30	19	6	2	0
h. Utilization of time. .	100	0	59[c,d]	29	10	1	X[e]	1
i. Utilization of time. .	100	0	50	36[c]	12	2	X[e]	0
k. Utilization of time. .	100	X[e]	37	43	18	1	0	X[e]
b. Attendance	100	0	42	26	19	6	X[e]	6
c. Attendance	100	0	61[c,d]	27	4	7	X[e]	X[e]
d. Attendance	100	0	52[c,d]	27	11	2	1	6
e. Attendance	100	0	53[c,d]	34	10	3	0	0
f. Attendance	100	0	61[c,d]	28	10	0	1	X[e]
g. Attendance	100	0	61[c,d]	25	11	2	0	X[e]
j. Consults Supervisor. .	100	0	54[c,d]	32	14	0	0	0
3. Reliability								
7 items.	100	X[e]	39	38	18	2	X[e]	3
Each item[b] of								
a. Techniques	100	0	57	37[c,d]	6	X[e]	0	0
b. Techniques	100	0	51	35[c,d]	13	1	0	0
c. Judgment	100	1	28	45	23	3	0	0
d. Judgment	100	0	23[c,d]	38	30	5	0	3
f. Judgment	100	0	49	37[c]	12	2	0	X[e]
g. Judgment	100	X[e]	33	37	23	3	1	2
e. Quality Control. . . .	100	0	29	38	19	1	0	13

TABLE 12
JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS WHO PASSED THE CERTIFICATION EXAMINATION
(continued)

Item	Total of 175 M. T.	No Reply	Job Performance Rating					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
4. Initiative								
12 items	100	2	26	30[c]	24	6	3	10
Each item[b] of								
a. Work accomplishment . .	100	0	37	30	23	7	1	X[d]
c. Work accomplishment . .	100	0	25[c]	37	25	7	0	7
d. Work accomplishment . .	100	0	40	34	21	3	0	1
f. Work accomplishment . .	100	0	34	41	20	3	X[d]	1
e. Continuing Education .	100	0	17	30	40[c,d]	10	2	2
g. Continuing Education .	100	11	29	17	17[c,d]	7	10	10
h. Continuing Education .	100	6	18	16	26[c,d]	13	10	13
i. Continuing Education .	100	0	19	25	25[c,d]	5	3	23
j. Continuing Education .	100	2	9	23	27[c,d]	5	5	29
b. Personal Relations . .	100	0	42	34	18	3	X[d]	2
k. Personal Relations . .	100	2	17[c,d]	35	31	3	X[d]	11
l. Teaching[j]	100	2	30	32	11	4	X[d]	21
5. Personal Relations								
11 items	100	X[d]	41	36	17	3	X[d]	3
Each item[b] of								
a. Peers	100	0	46	32	18	3	1	0
b. Peers	100	X[d]	42	34	19	5	0	X[d]
g. Peers	100	0	42	38	15	5	0	0
j. Peers	100	0	36	39	19	1	0	5
c. Supervisors	100	0	42	35	18	5	0	0
e. Supervisors	100	0	34	44	19	2	X[d]	0
d. Med. & Admin. Staff . .	100	X[d]	34	37	19	5	0	5
h. Lab. Asst. & Non-technical	100	X[d]	37	33	12	3	X[d]	14
i. Lab. Asst. & Non-technical	100	0	38	42	18	2	0	X[d]
k. Personal Appearance . .	100	0	51[c,d]	33	13	2	1	0
f. Patients	100	X[d]	47	28	10	3	0	11

Footnotes for Table 12

a. The "Total" is entered as 100% to indicate the direction of summation in this table. The actual sum of percentages varies from 99 through 102 because all are adjusted to the nearest whole number.

b. Letters preceding titles identify items in the rating form completed by the supervisor. The complete list of items is in the Appendix.

c. Comparison of item rating distributions for 175 technologists who passed the examination with means for ratings of all items for 193 technologists.[1] Calculation of chi square distributions (Kolmogorov-Smirnov formula) shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 63-66).

d. Comparison of item rating distributions for 175 technologists who passed the examination with means for ratings for all of them. Calculation of chi square distributions (Kolmogorov-Smirnov formula) shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 63-66).

e. X = Less than 1%.

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[1] See Table 11 for means for ratings of all items for 193 technologists.

TABLE 13

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS WHO FAILED THE CERTIFICATION EXAMINATION

Item	Total of 18 M. T.	No Reply	Job Performance Ratings					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for 60 items	% 100	% 3	% 39	% 30	% 19	% 3	% X[d]	% 5
Each category of								
1. Skills								
19 items	100	3	33	35	22	2	X[d]	6
Each item[b] of								
a. Techniques	100	0	44	33	22	0	0	0
b. Techniques	100	0	39	44	17	0	0	0
c. Techniques	100	0	33	39	22	6	0	0
e. Techniques	100	0	28	33	28	6	0	6
f. Techniques	100	0	22	44	22	6	0	6
d. Instrumentation.	100	0	39	28	22	6	6	0
g. Instrumentation.	100	6	17	17[c]	39	11	6	6
h. Quality Control.	100	0	33	28	28	0	0	11
i. Quality Control.	100	11	22	17	28	0	0	22
m. Quality Control.	100	6	22	56	6	0	0	11
j. Judgment	100	6	44	39	11	0	0	0
k. Judgment	100	0	39	33	17	0	0	11
l. Judgment	100	6	44	33	11	0	0	6
o. Judgment	100	0	50	33	17	0	0	0
p. Judgment	100	6	22	39	33	0	0	0
q. Judgment	100	0	22	50	17	0	0	11
n. Mathematics.	100	6	17	28	33	6	0	11
r. Efficiency	100	0	39	39	22	0	0	0
s. Efficiency	100	6	39	33	17	0	0	6

TABLE 13

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS WHO FAILED THE CERTIFICATION EXAMINATION (continued)

Item	Total of 18 M. T.	No Reply	Job Performance Ratings					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
2. Dependability								
11 items	100	6	59	21	11	1	0	2
Each item[b] of								
a. Utilization of Time . .	100	6	50	17	17	11	0	0
h. Utilization of Time . .	100	6	56	22	17	0	0	0
i. Utilization of Time . .	100	6	56	28	11	0	0	0
k. Utilization of Time . .	100	6	33	56	6	0	0	0
b. Attendance	100	6	56	17	17	0	0	6
c. Attendance	100	6	67[c]	11	17	0	0	0
d. Attendance	100	6	61	22	6	0	0	6
e. Attendance	100	6	67[c]	17	6	0	0	6
f. Attendance	100	11	67[c]	11	6	0	0	6
g. Attendance	100	6	78[c]	6	11	0	0	0
j. Consults Supervisor . .	100	6	56	28	6	6	0	0
3. Reliability								
7 items	100	4	39	36	15	2	0	4
Each item[b] of								
a. Techniques	100	6	56	28	11	0	0	0
b. Personal	100	6	50	39	6	0	0	0
c. Judgment	100	6	28	44	22	0	0	0
d. Judgment	100	6	17	50	17	11	0	0
f. Judgment	100	0	44	33	17	0	0	6
g. Judgment	100	0	39	28	22	6	0	6
e. Quality Control	100	6	39	28	11	0	0	17

TABLE 13

JOB PERFORMANCE RATING FOR MEDICAL TECHNOLOGISTS WHO FAILED THE CERTIFICATION EXAMINATION
(continued)

Item	Total of 18 M. T.	No Reply	Job Performance Ratings					
			Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
PERCENT[a] rated for each category of (Cont'd)	%	%	%	%	%	%	%	%
4. Initiative								
12 items	100	3	29	26	23	7	2	10
Each item[b] of								
a. Work Accomplishment . . .	100	6	39	33	11	11	0	0
c. Work Accomplishment . . .	100	0	22	50	11	11	0	6
d. Work Accomplishment . . .	100	0	39	28	28	6	0	0
f. Work Accomplishment . . .	100	0	39	44	17	0	0	0
e. Continuing Education . .	100	0	22	22	39	11	6	0
g. Continuing Education . .	100	22	22	11	33	0	0	11
h. Continuing Education . .	100	0	17	22	28[c]	17	6	11
i. Continuing Education . .	100	0	28	11	28[c]	11	6	17
j. Continuing Education . .	100	0	22	11	28[c]	0	6	33
b. Personal Relations. . . .	100	6	44	39	11	0	0	0
k. Personal Relations . . .	100	6	22	17	28[c]	6	6	17
l. Teaching	100	6	33	17	17	6	0	22
5. Personal Relations								
11 items	100	0	43	29	21	1	1	5
Each item[b] of								
a. Peers	100	0	56	28	17	0	0	0
b. Peers	100	0	39	33	28	0	0	0
g. Peers	100	0	50	22	28	0	0	0
j. Peers	100	0	39	28	17	0	0	17
c. Supervisors	100	0	39	39	17	0	0	6
e. Supervisors	100	0	33	39	22	6	0	0
d. Med. & Admin. Staff . . .	100	0	44	22	22	0	0	11
h. Lab. Asst. & Non-technical	100	0	39	33	22	0	0	6
i. Lab. Asst. & Non-technical	100	0	44	33	22	0	0	0
k. Personal Appearance . . .	100	0	50	28	17	0	6	0
f. Patients	100	0	39	22	17	6	0	17

Footnotes for Table 13

a. The "Total" is entered as 100% to indicate the direction of summation in this table. The actual sum of percentages varies from 99 through 102 because all are adjusted to the nearest whole number.

b. Letters preceding titles identify items in the rating form completed by the supervisor. The completed list of items in each of the five categories is in the Appendix.

c. Comparison of item rating distributions for 18 technologists who failed the examination with means for ratings of all items for 193 technologists.1/ Calculation of chi square distributions (Kolmogorov-Smirnov formula) shows that these figures are statistically significant because the frequency of replies exceeds the 0.05 probability level. Chi square values are recorded in the text of findings (pages 63-66).

d. X = Less than 1%.

1/ See Table 11 for means for ratings of all items for 193 technologists.

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APPENDIX A

Methodology

This report culminates Part 1 of the Medical Technology Study, which was designed to acquire information on relationships between educational achievement, national certification examination scores and job performance of medical technologists.

The medical technologists surveyed were selected from the 1,861 candidates filing for the July 1962 certification examination administered by the Board of Registry of Medical Technologists (ASCP)1/. This group was selected because the majority have sufficient working experience to enable completion of the technologists questionnaire and for their laboratory supervisors to evaluate their job performance.

The office of the Registry defines nine education groups for classifying examinees according to academic attainment, ranging from high school diploma to doctorate. The following three education groups were selected for this study as representing the largest portion of examinees in July 1962:

Education Group 3: Individuals completing four years of higher education, of which three are in pre-clinical study and one in clinical study 2/, but holding no baccalaureate degree.

Education Group 5: Individuals with educational preparation as described for Group 3, and possessing the degree Bachelor of Science in Medical Technology.

Education Group 6: Individuals completing five years of higher education, of which four are in pre-clinical study and one in clinical study, and possessing the degree Bachelor of Science or Bachelor of Arts.

Of the 1,861 applicants for the July 1962 examination, 1,353 were classified in Education Groups 3, 5 and 6. The number of successful candidates from these groups was 1,179, and the number of unsuccessful candidates was 174.

Participants in the study were selected randomly with an IBM 7040 computer at the University of Kentucky Computer Center. Programming for the sample was supervised by Wellington B. Stewart, M.D., Chairman of the Board of Registry of Medical Technologists (ASCP). Sample selection and size were validated by selecting three groups comprising about 10% of the examinees in each Education Group filing for the examination. This resulted in a total of 461 for the study population of whom 393 had passed the certification examination and 68 had failed. The population was further reduced by sixteen whose addresses were unavailable or who were outside the United States, and by one because of duplicate selection. Education Group 5 was then augmented by three through manual selection, resulting in a final population of 447 divided as to 381 successful and 66 unsuccessful candidates.

1/ Registry of Medical Technologists of the American Society of Clinical Pathologists, Muncie, Indiana.

2/ "Pre-clinical Study" in this context refers to the academic study of physical, biological and medical sciences and elected liberal arts courses in a college or university accredited by an agency recognized for such purposes by the U.S. Commissioner of Education.

"Clinical Study" in this context refers to the study and practice of medical laboratory techniques in a medical laboratory accredited as a school of medical technology by the Council on Medical Education of the American Medical Association. Credit hours for clinical study may be awarded by a college or university affiliated with the laboratory.

The office of the Registry of Medical Technologists maintains a file for each medical technologist filing for certification examination, containing a transcript of college credit hours earned (or, absent the transcript, a form summarizing credit hours accepted toward fulfillment of prerequisites) and a performance evaluation from the school of medical technology attended. From this file, for each of the 447 technologists comprising the sample population, the number of credit hours earned in each science course 3/ was transferred to a keypunch code sheet according to grade received: one set of columns for credit hours earned in A, B and C grades ("satisfactory performance"), another set for credit hours earned in D and F grades ("unsatisfactory performance").

The number of total credit hours earned was recorded separately from the number of credit hours earned in science courses, without indication of grades. A summary of grades for all credit hours earned by each technologist was recorded in a separate column of the keypunch code sheet. The grades were grouped in nine units as follows: A, A-B, A-B-C, A-B-C-D, A-B-C-D-F, B-C, B-C-D, B-C-D-F and C-D-F.

Performance evaluations of clinical study are recorded and confirmed by directors of schools of medical technology on forms provided by the office of the Registry. Information from these forms was transferred to keypunch code sheets in numbers 1 through 5, representing the ratings "excellent", "good", "average", "poor" and "fail". Ratings were recorded separately for the laboratory divisions hematology, urinalysis, bacteriology, parasitology, chemistry, blood bank, serology, mycology and histologic technique.

The Registry office provided identification numbers for each AMA-approved school of medical technology within each state attended by the technologists surveyed.

Raw scores from the July 1962 certification examination were also provided by the Registry office. These include scores for each section as well as for the entire examination. They were entered on IBM cards by J. L. Arbogast, M.D., a member of the Board of Registry, through the facilities of the University of Indiana.

The Board of Schools of Medical Technology (ASCP) permitted use of the annual reports filed with its office for the 723 schools approved by the Board in 1961. These reports provided descriptive data regarding qualifications of school directors, qualifications and size of technical staffs, laboratory workloads, and related information which were also transferred to keypunch code sheets.

During March 1965, questionnaires were sent from the National Council on Medical Technology Education to each of the 447 technologists in the study population requesting information concerning their location, type and length of employment, and various matters relating to their work. Each of the technologists was also requested to submit the name of his immediate laboratory supervisor. (This questionnaire is reproduced in Appendix C.) Completed questionnaires were returned by 332 of the 447 examinees (72%). Of these, 247 (55%) reported they were currently employed; 24 (5%) were not then employed but had been within the previous six months; 29 (7%) returned incomplete questionnaires; and 22 (5%) of the questionnaires were returned, undelivered, because of incorrect address. Of the 271 who were currently or recently employed, 242 had passed the 1962 certification examination and 29 had failed.

Each of the laboratory supervisors named by the reporting technologists were then sent two questionnaires by NCMTE, during April and May of 1965. On questionnaire "A" each supervisor was asked to evaluate the job performance of the technologist indicated, according to 60 items relating to Skills, Dependability, Reliability, Initiative and Personal Relations. The ratings were recorded by six indices, "excellent", "above average", "average", "less than average", "unsatisfactory" and "does not apply". On questionnaire "B" each supervisor was asked to provide information relating to his own education and work experience. (These questionnaires are reproduced in Appendix D.) Of the 254 supervisors surveyed, 193 responded.

3/ I.e., courses in the physical, biological and medical sciences. Those for which separate entries were made were inorganic chemistry, qualitative analysis, quantitative analysis, organic chemisty, biochemistry, zoology, botany/biology, physiology/anatomy, histology, genetics, eugenics, bacteriology, parasitology, embryology, mathematics, physics and "other sciences".

Each of the medical technologists was assigned a study number, consecutively, according to the "Pass" and "Fail" groups and samples. This system facilitated distinction of the "Pass" and "Fail" groups and samples. Of the 66 medical technologists who failed the July 1962 examination, 38 subsequently passed and received certificate numbers, and 28 either had not passed or did not attempt later examinations so they do not have certificate numbers. Study numbers were assigned to the laboratory supervisors as their completed forms were received by the NCMTE.

All data were organized and assigned to the following decks of IBM cards:

Deck 1: Information from the forms returned by the medical technologists (Questionnaire to Examinee) N = 271

Deck 2: Academic credit hours taken by the medical technologists (College transcript of credit from Registry office files) N = 444 4/

Deck 3: Total and section raw scores for each medical technologist for the July 1962 medical technologist examination. (Duplicates of IBM cards provided by J. L. Arbogast, M.D., University of Indiana.) N = 444 4/

Deck 4: Information from the 1961 and 1962 annual reports of the schools of medical technology. (From files of the office of the Board of Schools of Medical Technology of the ASCP) N = 723

Deck 5: Code number and enrollment of the colleges and universities with which schools of medical technology are affiliated. (From 1961 annual reports of the schools of medical technology, "Barron's Guide to Two Year Colleges" and "Barron's Profile of American Colleges" published 1960 and 1964 respectively.) N = 723

Deck 6: Ratings of medical technologists' job performances (Supervisor's Form A) N = 193

Deck 7: Information about education and working experience of laboratory supervisors. (Supervisors Form B) N = 193

Deck 8: Evaluation of medical technologists' performances in the schools of medical technology (Forms from Registry office files) N = 444

Each card in each deck was commonly identified by the technologists' and laboratory supervisors' Registry certificate number (where applicable), and respective study number.

All data were processed on an IBM 1620 computer at the Yalem Scientific Computer Center at St. Louis University (St. Louis, Missouri) under the direction of Mr. Richard Conger, Mr. Robert Sullivan and Miss Marguerite Inglis. The relationships attempted and reported are derived from discussions by members, staff and consultants of the National Council on Medical Technology Education. Findings are derived from single and double column item analysis of data on all decks of cards; correlations of college credit hours and examination raw scores; arithmetic means of credit hours, examination raw scores, and school and job performance ratings; and chi square distribution. Programs for all analyses were written by Mr. Conger at the Yalem Scientific Computer Center.

On each of decks 1, 2, 6, 7 and 8 the item analysis was performed on each of the three samples and on the combination of samples to prove that the study population is statistically random and to determine the approximate portion of a group that may be used confidently in subsequent studies. The data from decks 1, 2, 4, 6, 7 and 8 were summarized in chart form to facilitate preparation of study results and conclusions.

Statistically significant relationships were determined through use of the chi square and Kolmogorov-Smirnov formulae. A representative sample of each, drawn from this study, is reproduced below.

4/ N = 444 because the college transcripts of credit for three medical technologists could not be converted to keypunch coding.

CHI SQUARE CALCULATION

Statement: Significantly more people working as generalists in medical technology are in laboratories in hospitals of less than 200 beds and outside of hospitals.

Item	Number of Medical Technologists in Laboratories			
	Hospitals			Outside of Hospitals
	1-199 Beds	200-399 Beds	400 & More Beds	
Specialists	18	59	39	20
Generalists	38	36	11	42

Calculation of Theoretical Frequency

Formula: $f_t = \frac{(r_t)\ (k_t)}{N}$

f_t = Theoretical Frequency
r_t = Total of row in which cell falls
k_t = Total of column in which cell falls
N = Grand total for table

Item	1-199 Beds		200-399 Beds		400 & More Beds		Outside of Hosp.		Total (r_t)
	f_o	f_t	f_o	f_t	f_o	f_t	f_o	f_t	
Specialists	18	28.96	59	49.13	39	25.86	20	32.06	136
Generalists	38	27.04	36	45.87	11	24.14	42	29.94	127
Total (k_t)	56		95		50		62		263

f_o = Observed Frequency

$$f_t = \frac{(136)\ (56)}{263} = 28.96$$

$$f_t = \frac{(127)\ (56)}{263} = 27.04$$

$$f_t = \frac{(136)\ (95)}{263} = 49.13$$

$$f_t = \frac{(127)\ (95)}{263} = 45.87$$

$$f_t = \frac{(136)\ (50)}{263} = 25.86$$

$$f_t = \frac{(127)\ (50)}{263} = 24.14$$

$$f_t = \frac{(136)\ (62)}{263} = 32.06$$

$$f_t = \frac{(127)\ (62)}{263} = 29.94$$

(Continued on next page)

$$\text{Chi square} = \sum \frac{(f_o - f_t)^2}{f_t}$$

Σ = Sum of
f_o = Observed Frequency
f_t = Theoretical Frequency

$$\frac{(18-28.96)^2}{28.96} + \frac{(38-27.04)^2}{27.04} + \frac{(59-49.13)^2}{49.13} + \frac{(36-45.87)^2}{45.87} + \frac{(39-25.86)^2}{25.86} + \frac{(11-24.14)^2}{24.14} +$$

$$\frac{(20-32.06)^2}{32.06} + \frac{(42-29.94)^2}{29.94}$$

Chi square = 4.15 + 4.44 + 1.98 + 2.12 + 6.68 + 7.15 + 4.54 + 4.86 = 35.95

Degrees of Freedom = (Number of Rows - 1) (Number of Columns - 1)

Degrees of Freedom = (2 - 1) (4 - 1) = (1) (3) = 3

Reference Table: Chi square for 0.05 Probability at 3 degrees of freedom is 7.81

CHI SQUARE CALCULATION USING KOLMOGOROV-SMIRNOV FORMULA

Statement: Significantly more of the medical technologists were rated "average" or below in Skills referring to instrumentation.

Item	Number of Medical Technologists Rated					
	Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
60 Items	72	66	35	7	2	9
Skills: Instrumentation	27	42	76	29	6	9

Item	Cumulative Proportion of Number of M.T. Rated					
	Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
$S_{191}T$	72/191	138/191	173/191	180/191	182/191	191/191
$S_{189}I$	27/189	69/189	145/189	174/189	180/189	189/189

Item	Cumulative Proportion of Number of M.T. Rated					
	Excellent	Good	Average	Less than Average	Unsatis-factory	Does Not Apply
$S_{191}T$	.377	.723	.906	.942	.953	1.000
$S_{189}I$	.143	.365	.767	.921	.952	1.000
$S_{191}T - S_{189}I$	.234	.358	.139	.021	.001	0.000

$S_{191}T$ = Cumulative proportion distribution of M.T.'s rated in 60 items

$S_{189}I$ = Cumulative proportion distribution of M.T.'s rated in Instrumentation item.

Formula: $\mathrm{Chi}_k^2 = \dfrac{4D^2\,(N_1)(N_2)}{N_1 + N_2}$

D = Largest class difference between accumulative frequencies of 2 samples

N_1= Total number of persons rated for 60 items

N_2= Total number of persons rated for Instrumentation item

$$\mathrm{Chi}_k^2 = \frac{4(.358)^2(191)(189)}{191+189} = \frac{4(.128164)(36,099)}{380} = 48.71$$

Degree of freedom for this formula is always 2

Chi square for 0.05 Probability at 2 degrees of freedom is 5.99

APPENDIX B
History

The National Council on Medical Technology Education grew out of a concerted effort over an eight-year period to appraise the educational preparation of medical laboratory personnel.

In October 1956 the Medical Technology Study Committee (an ad hoc joint committee of the American Society of Clinical Pathologists and American Society of Medical Technologists) met with research consultants and representatives of medical, paramedical and hospital organizations to assess various professional and legislative facets of medical technology. This deliberation culminated in the recommendation that the National Committee for Careers in Medical Technology [1] endeavor to obtain financial support for a national study of the education and utilization of medical laboratory personnel. Several attempts to do so were unsuccessful.

The Alabama Project

Three years later, in 1959, the National Committee for Careers in Medical Technology did obtain funds to conduct a pilot study on medical technology education in Alabama. This "Alabama Pilot Study" (subsequently known as the Alabama Project) developed from requests by the Alabama State Society of Medical Technologists and American Society of Medical Technologists and was financed through the Cancer Control Program of the United States Public Health Service. Its objectives were

1. to find ways and means of increasing and improving the quality of medical technology instruction in Alabama;
2. to find ways of increasing cancer cytologic training of medical technologists; and
3. to provide specialized cytologic training.[2]

The Alabama Project was supervised by Joseph A. Cunningham, M.D. (Project Director), Mrs. Sara Crowson, M.T.(ASCP) and Mrs. Frances Wideman, M.T.(ASCP) (Field Coordinators). It was conducted in three phases.

During Phase I, the staff assembled information on current programs in schools of medical technology through surveys designed to explore the following areas of need:

"1. Encouraging formalization of the schools of medical technology,
2. Faculty development,
3. Developing resource material,
4. Assisting teaching supervisors in improving their skills,
5. Strengthening the interest of Alabama colleges in the teaching programs of the AMA-Approved schools,
6. Cooperation with recruitment efforts of the Alabama State Society of Medical Technologists."

---

[1] The National Committee for Careers in Medical Technology is an incorporated organization consisting of representatives of the American Society of Clinical Pathologists, American Society of Medical Technologists and College of American Pathologists.

[2] The Alabama Pilot Study. Final report of a three-year project (1959-1962) for the improvement of medical technology education. Sponsored by the National Committee for Careers in Medical Technology through the United States Public Health Service Contract #73071.

These surveys were evaluated at a meeting of school directors and teaching supervisors where priorities were assigned in the following order:

1. Budgetary considerations,
2. Space requirements,
3. Strengthening college affiliations,
4. Improving communications among schools of medical technology,
5. Providing teaching aids, and
6. Developing teaching skills of instructors.

These suggestions were implemented in Phase II through a conference of directors of six schools of medical technology and ten Alabama colleges. They recommended that

1. representatives of the programs concerned meet every third year to review their respective programs and the success of their graduates in the certification examination administered by the Registry of Medical Technologists (ASCP); and
2. respective facilities of closely affiliated colleges and schools of medical technology meet annually to discuss student deficiencies.

Communications between schools of medical technology were facilitated through publication of a newsletter, "The Alabama Pilot". Methods for developing teaching skillls were introduced to instructors through

1. seminars on student evaluation and difficulties with teaching methods in medical technology;
2. a course on problem situations in supervision; and
3. workshops in the preparation and use of teaching aids, laboratory instrumentation and fluorescence microscopy.

In addition, the preparation and use of teaching aids were emphasized by publishing and distributing lists of pertinent films, film strips and slide collections; and acquiring films and slides in blood banking, coagulation, blood cell morphology, cytology and histologic technique.

The objectives relating to cytotechnology were implemented through a survey of Alabama pathologists to determine needs for instruction and recruitment in medical technology. The project activities included

1. acquisition of scholarship funds for student support,
2. development of instructional material,
3. publication of a newsletter for the exchange of information among schools of cytotechnology,
4. intensive recruitment of students, and
5. a workshop in endometrial carcinoma.

Phase III comprised the evaluation of all project activities which indicated progress in all areas and emphasized needs for and interest in their continuation.

The National Council on Medical Technology Education

In October 1962 a group of 24 representatives of agencies concerned with education in medical technology and cytotechnology met to study the findings and recommendations of the Alabama Project. They recommended unanimously "...that a pilot study be set up to test whether a central education office could do for all Approved Schools of Medical Technology the many things accomplished by the Alabama Project for the Alabama Schools as well as fulfilling other needs."2/

As a direct consequence, the National Council on Medical Technology Education was formed in July 1964 under the sponsorship of the National Committee for Careers in Medical Technology and through the support of the Cancer Control Branch of the Division of Chronic Diseases, United States Public Health Service.3/ The N.C.C.M.T. chairman, Robert Horn, Jr., M.D. , appointed as members of the Council

Merlin L. Trumbull, M.D. (Chairman and Project Director)
Nellie May Bering, B.S.,M.T.(ASCP)
Joseph A. Cunningham, M.D.
Mary Frances James, M.S.,M.T.(ASCP)
John B. Miale, M.D.

3/ Community Cancer Demonstration Project Grant Number 5514-A-65

He appointed as staff and consultants
Ruth I. Heinemann, B.S.,M.T.(ASCP) (Program Coordinator)
W. I. Christopher, M.H.A. (Consultant)
Robert Richart, Ph.D. (Consultant)
Subsequent appointments include
Arch Lugenbeel, M.Ed. (Education Associate)
Frances Kaplan, M.A. (Consultant)
Arline Howdon, B.A.,C.T.(ASCP) (Consultant)
Irma Rube, M.S.,C.T.(ASCP) (Consultant)
Drs. Trumbull and Miale resigned in 1966 and were replaced by Rex D. Couch, M.D. and Tyra T.. Hutchens, M.D.

In their first meeting in October 1964 the members of the Council concurred in a need for further baseline information about medical technology education prior to implementation of the Alabama Project recommendations. This conviction derived from the realization that various boards and committees involved in the education and certification of medical technologists were then considering the basic question of whether or not current and future demands in this rapidly developing profession were being met through established programs of education in medical technology. Accordingly, they took action to confine their intitial projects to studies in depth of the academic, technical, graduate and continuing education programs for medical technologists, cytotechnologists and certified laboratory assistants in order to determine directions of future service in the development of these programs.

The projects initiated by the Council to date are

1. Medical Technologist Study, Part I; and Certified Laboratory Assistant Study, Part I. These two surveys are intended to examine the relationships between educational preparation and job performance of laboratory personnel.
2. Back-to-Work Project. This project consists of the location of medical technologists not currently active in their profession and the organization of retraining programs for those who wish to resume such activity.
3. Continuing Education. Following development of a training grants program for experienced medical technologists, the Council intends to survey existing graduate degree programs and to assist in the establishment of new programs.
4. Community College. A joint committee of the National Council on Medical Technology Education and the American Association of Junior Colleges has been formed to consider guidelines for curricula appropriate for two-year colleges in medical laboratory personnel education.

This report constitutes the completion of the Medical Technologist Study, Part I.

APPENDIX C

Questionnaire to Examinee and Introductory Letters

NATIONAL COUNCIL ON MEDICAL TECHNOLOGY EDUCATION
1025 E. H. Crump Boulevard
Memphis, Tennessee 38104

MEDICAL TECHNOLOGY EDUCATION STUDY
PHASE I

Questionnaire to Examinee

(Note: You do not need to be concerned about the columns on the left side of each page "IBM, Col., Item". They will be used later for analysis of the data.)1/

1. Name: ______________________________
(Last) (First) (Middle) (Maiden)

2. ASCP Registry Number: ______________________________

3. Home Address: ______________________________
(Street)
____
(City) (State) (Zip Code)

4. Place of Employment
   a. Name of Institution: ______________________________

   Address: ______________________________
   (Street)
   ____
   (City) (State) (Zip Code)

   b. Name of Director of Laboratory: ______________________________
   ____

   1) _____ Pathologist
   2) _____ Non-Pathologist, M.D.
   3) _____ Non-M.D.
   4) _____ Full Time
   5) _____ Part Time
   6) _____ Consultant only (Infrequent visit)

   Address (If consultant or part time) ______________________________
   ____
   (Street)
   ____
   (City) (State) (Zip Code)

   c. Length of time you have worked at this institution:
   1) _____ 0- 6 months
   2) _____ 7-12 months
   3) _____ 13-18 months
   4) _____ 19-24 months
   5) _____ 25-30 months
   6) _____ 31-36 months
   7) _____ Other ______________________________
   ____

1/ Columns on the left for IBM analysis are deleted in this reproduction of the questionnaire

d. Title of your position: (Check item (or items) below that is (are) closest to your title)
1) _____ Staff Medical Technologist
2) _____ Research Medical Technologist
3) _____ Section Supervisor in ______________________________ (department)
4) _____ Chief Medical Technologist
5) _____ Teaching Supervisor
6) _____ Assist with teaching: _____ At laboratory "bench"
7) _____ Assist with teaching: _____ Give some lectures
8) _____ Other ______________________________

e. Length of time in your present position:
1) _____ 0- 6 months
2) _____ 7-12 months
3) _____ 13-18 months
4) _____ 19-24 months
5) _____ 25-30 months
6) _____ 31-36 months
7) _____ Other ____________________

5. What kind of a laboratory are you working in and what hours are you working (employment status)? Please check the appropriate replies below.

a. Kind of laboratory
_____ Hospital
_____ Clinical
_____ Scheduled rotation in all or most departments
_____ Departmentalized: Working in ______________________________
______________________________ (department)
_____ Research: Working in _____ Hematology
_____ Chemistry
_____ Microbiology
_____ Blood Bank
_____ Histopathology
_____ Radioisotopes
_____ Other ______________________________
____
_____ Private Laboratory (Non-hospital)
_____ In all departments
_____ Departmentalized: Working in ______________________________
______________________________ (department)
_____ Industry
_____ Clinical Laboratory
_____ Research: Working in _____ Hematology
_____ Chemistry
_____ Microbiology
_____ Blood Bank
_____ Histopathology
_____ Radioisotopes
_____ Other ______________________________
_____ Public Health (City, County, State)
_____ Microbiology
_____ Serology
_____ Clinical (several departments)
_____ Research: Working in _____ Microbiology
_____ Serology
_____ Clinical
_____ Doctors' office (only technologist serving 1 to 4 physicians)
_____ Clinic (1 of 2 or more technical staff serving 5 or more physicians)

b. Employment Status:
_____ Full Time
  1) _____ Day
  2) _____ Day and weekend rotations
  3) _____ Day and night rotations
  4) _____ Day, weekend and night rotations
  5) _____ Relief (3pm-11pm, 11pm-7am, 3pm-7am, or the like)
  6) _____ Night Call
  7) _____ 24 hour
  8) _____ Other ____________________
_____ Part Time
  1) _____ Day (Regularly scheduled)
  2) _____ Relief (3-11pm or the like)
  3) _____ Night Call
  4) _____ Weekend only
  5) _____ On call, as needed
  6) _____ Other ____________________

6. What quality control measures are you using now and what did you learn as a student?

a. What quality control measures do you use regularly in your present job in the appropriate instances?
1) _____ Pooled sample (serum, cells, plasma, hemoglobin, etc.)
2) _____ Commercially available pools such as Labtrol, Versatol
3) _____ Clinical Chemistry, etc. 2/
4) _____ Standards (solutions of known concentration)
5) _____ Recovery
6) _____ Duplicates of unknowns
7) _____ Known positive samples
8) _____ Other ____________________

b. When you were a student in the School of Medical Technology, did you calculate the mean, standard deviation and range of a quality control sample?
1) _____ No
2) _____ No, but was asked to do so
3) _____ Yes, once
4) _____ Yes, helped someone
5) _____ Yes, several times

c. Have you calculated the mean, standard deviation and range of a control sample since you were a student in the School of Medical Technology?
1) _____ No
2) _____ No, but have been asked to do so
3) _____ Yes, often
4) _____ Yes, occasionally
5) _____ Yes, once
6) _____ Yes, have helped someone

d. When you were a student in the School of Medical Technology, did you maintain and use charts of control sample values to observe the trend?
1) _____ No, there were none in the laboratories
2) _____ No, they were used by laboratory staff
3) _____ Yes, occasionally
4) _____ Yes, regularly

e. Do you maintain and use charts of control samples to observe the trend of control sample values?
1) _____ No
2) _____ No, but have heard of them
3) _____ Yes, do so regularly
4) _____ Yes, do so occasionally
5) _____ No, but others in the laboratory do so

2/ Separate listing of "Clinical Chemistry, etc." was a typographical error in the original questionnaire. This was adjusted in the computation of replies.

7. How often do you consult your immediate supervisor for help with laboratory problems?
    1) _____ Daily
    2) _____ Weekly
    3) _____ Monthly
    4) _____ Seldom
    5) _____ Never

8. Do you help in making decisions about the purchase of equipment, reagents, etc.?
    1) _____ Yes
    2) _____ No
    3) _____ Have complete responsibility for decisions about purchasing

9. Have your duties and responsibilities been clearly defined for you by your immediate supervisor?
    1) _____ Yes   2) _____ No

10. Do you feel that you have been given the responsibility to use independent judgment in the performance of your duties?
    1) _____ Yes   2) _____ No

11. Do you freely discuss problems in laboratory tests or confer about patients' conditions with physicians or those who request work in your laboratory? (or confer about research problems, as the case may be)
    1) _____ Yes   2) _____ No

12. Do you feel that your education has prepared you adequately to perform the duties assigned to you in your work?
    1) _____ Yes   2) _____ No

    If not, what additional education do you feel you need? ______________________________

    ____

    ____

13. What kind of continuing education have you had since you left your formal education?
    _____ Professionally oriented
    1) _____ Graduate School (list courses)

    ____

    ____

    2) _____ Organization meetings (list)

    ____

    ____

    3) _____ Seminars (list)

    ____

    ____

    4) _____ Workshops (list)

    ____

    ____

    5) _____ Other (list)

    ____

    ____

    _____ Socially oriented (Summarize type of education not related to medical technology)

    ____

    ____

Please read questions 14 and 15 carefully before replying.

14. What laboratory determinations (tests) have you learned to do on your job(s) that you did not learn when you were a student? Please list them below.

15. What laboratory determinations (tests) did you learn to do as a student that you have not done on your job(s)? Please list them below.

16. We would like to contact the person who is directly responsible for supervising your work (your immediate supervisor) to obtain information about conditions of work in your laboratory. We will appreciate your giving us the name, title and address of your immediate supervisor.

Name __________

Title __________

Address __________
(Street)

(City) (State) (Zip Code)

Thank you for your assistance.

3-26-65

NATIONAL COUNCIL ON
Medical Technology Education
1025 E. H. Crump Boulevard, Memphis, Tenn. 38104
area 901 *phone 526-6581*

research associate: RUTH I. HEINEMANN, MT (ASCP) *education associate:* ARCH LUGENBEEL
council members: REX D. COUCH, M.D., CHAIRMAN; NELLIE MAY BERING, MT (ASCP); JOSEPH A. CUNNINGHAM, M.D.; MARY FRANCES JAMES, MT (ASCP); TYRA T. HUTCHENS, M.D.; AND ROBERT W. COON, M.D., EX OFFICIO

(Personally addressed to medical technologist (examinee). Accompanied "Questionnaire to Examinee".)

In October 1964, the National Council on Medical Technology Education was established by the National Committee for Careers in Medical Technology through funds provided by the Cancer Control Program of the U.S. Public Health Service. General Information about the Council is enclosed. You will note that the American Society of Medical Technologists and the American Society of Clinical Pathologists have demonstrated interest in the Council's study of various aspects of medical technology education.

The first phase of our project is to study how medical technology education relates to the work done in the field. In order to uncover the pertinent relationships between education and work, we have devised certain questions for which we need answers. We selected a sample of people from the group which took the ASCP Registry examination in medical technology in July 1962. We think that representatives of this group are qualified to answer our questions. You are one of those selected from this group. Enclosed is the questionnaire designed to obtain information about you and your work. Most questions can be answered easily by checking an appropriate reply. Please complete and return it in the enclosed self-addressed envelope as soon as possible. Your replies will be kept in confidence.

Medical technologists and pathologists are giving much time and effort to the development of education in medical technology. The establishment of the National Council on Medical Technology Education provides an opportunity to clarify these efforts. By completing and returning the questionnaire promptly you will contribute to the efforts of the Council in the furtherance of medical technology education.

Thank you for your interest in participating in this study.

Sincerely,

Ruth I. Heinemann, M.T.(ASCP)
Program Coordinator

RIH/nr

NATIONAL COUNCIL ON

Medical Technology Education

1025 E. H. Crump Boulevard, Memphis, Tenn. 38104

area 901 *phone 526-6581*

research associate: RUTH I. HEINEMANN, MT (ASCP) *education associate:* ARCH LUGENBEEL

council members: REX D. COUCH, M.D., CHAIRMAN; NELLIE MAY BERING, MT (ASCP); JOSEPH A. CUNNINGHAM, M.D.; MARY FRANCES JAMES, MT (ASCP); TYRA T. HUTCHENS, M.D.; AND ROBERT W. COON, M.D., EX OFFICIO

(Follow-up letter to medical technologists to solicit return of questionnaires.)

Several weeks ago you should have received a letter and form from the office of the National Council on Medical Technology Education asking you to participate in a study. You are one of 447 people selected for the study from the group taking the July 1962 ASCP Registy examination. To date we have received replies from 260 people. If possible, we would like to hear from everyone to know whether or not each is employed and, if so, to have the replies to the items in the form.

Since we have not heard from you, this is to remind you to return the form with an appropriate reply. If, for some reason, you have not received the letter and form, please let us know immediately so that we may send them to you.

We will appreciate hearing from you within the next two weeks.

Sincerely,

Ruth I. Heinemann, M.T.(ASCP)
Program Coordinator

RIH/nr

APPENDIX D

Questionnaire to Laboratory Supervisors and Introductory Letters

NATIONAL COUNCIL ON MEDICAL TECHNOLOGY EDUCATION

Supervisor's Form

Supervisor of Registrant #__________ Supervisor Study # __________

Form A: On the attached sheets there are 8 major items to be considered in evaluating personnel. Under each of the first 5 there are statements which describe activities and attitudes of personnel which can be considered by supervisors in determining the level of job performance. Please read each statement carefully and rank the medical technologist under consideration. Please use the following scale for ranking purposes:

1 = Excellent performance
2 = Good performance
3 = Average performance
4 = Less than average performance
5 = Unsatisfactory performance
6 = Does not apply

Write the appropriate number in the space provided at the left of each statement. (Note: You do not need to be concerned about the columns on the extreme left side of each page "IBM, Col., Item". They will be used later for analysis of the data.)[1] Although the statements should apply to all laboratory situations, there is the possibility that a few may not be pertinent to yours. If any statement does not apply to your situation, rank it as 6.

Items 6, 7 and 8 are self-explanatory.

Since this is a study, please bear in mind that this form is not designed for general use as an evaluation tool. It should not be used as such until its worth has been demonstrated.

Form B: In addition to the evaluation of the medical technologist, we would like to have identifying information about you. We will appreciate your completing the enclosed form for that purpose.

Thank you for your assistance.

---

[1] Columns on the left for IBM analysis are deleted in this reproduction of the quesionnaire

NATIONAL COUNCIL ON MEDICAL TECHNOLOGY EDUCATION

SUPERVISOR'S FORM A

Supervisor of Registrant # ____________ Supervisor Study # ____________

Rating

1. Skills

____ a. Consistently uses good technique in performing laboratory tests.

____ b. Has good manual dexterity.

____ c. Readily learns to use new equipment.

____ d. Leaves mechanical equipment clean and in good working order after use. (Such as microscopes, colorimeters, Van Slyke, electrophoresis cells, etc., pH meters, cell counters, burettes, automatic pipettes, etc.)

____ e. Inspects glass and plastic ware to be sure it is clean.

____ f. Takes necessary precautions to keep glass and plastic ware clean.

____ g. Makes or is able to make simple adjustments and repairs of electrical, mechanical and optical equipment without specific instructions from supervisor.

____ h. Participates in quality control procedures by regularly using appropriate pooled samples, prepared samples, recovery solutions, standard solutions, duplicate determinations, etc. that may be specified for procedures.

____ i. Calculates or has demonstrated ability to calculate the mean, standard deviation and range values of quality control values.

____ j. Readily accepts and puts into practice changes in technical procedures that are recommended by supervisor.

____ k. Participates in trying and proving new methods and procedures.

____ l. Regularly reviews the results of his own work critically to avoid reporting errors in calculations.

____ m. Knows normal and abnormal values for determinations and relates them to the patient's condition or provisional diagnosis to be sure that all reports are logical.

____ n. Understands the derivation of formulae (calculations) involving dilution factors, correction factors, etc. so that substitutions in formulae are made to account for unusual conditions of doing determinations.

____ o. Records and reports all findings thoroughly.

____ p. Has demonstrated ability to apply basic knowledge to practical situations to solve problems with procedures.

____ q. Detects and corrects errors made by others which were reported on patient's record. Reports such corrections to supervisor.

____ r. Organizes work efficiently so that the necessary quantity of work is completed with desirable quality of performance.

____ s. Is able to coordinate work activities so that tests can be done simultaneously in more than one section of the laboratory. (For example: starting a crossmatch, doing a hemoglobin, white count and differential; and doing a urinalysis.)

2. Dependability

____ a. Arrives at laboratory on time and begins work promptly. (Note: Consider not only arrival to begin work but also return from lunch periods and coffee breaks.)

____ b. Volunteers a reasonable number of times for changes in schedule or extra duty as required by circumstances. (Shares this proportionately with other members of the staff.)

____ c. Amount of sick leave taken has been minimal and justified.

____ d. Requests for annual leave (vacation) have been reasonable (within established policy) and considerate of the total staff.

____ e. Special requests of unplanned short absences have been minimal or nonexistent. (Doctors', Dentists', or other special appointments.)

____ f. Gives notice of absence sufficiently in advance so that laboratory work schedule can be satisfactorily adjusted.

____ g. Remains on duty until all work assigned to her (him) is completed.

Rating

_____ h. Does not habitually ask others to complete or assist with completion of work assignments.
_____ i. Will accept duties and instructions given by supervisor and will complete them without further reminder. (That is, requires a minimum amount of supervision.)
_____ j. Consults supervisor about unusual problems and/or situations (technical and/or administrative) when necessary.
_____ k. Plans work to meet all ordinary and most unusual situations.

3. Reliability
_____ a. Follows technical procedures as outlined in the laboratory using instructions as guides.
_____ b. Abides by established personnel and other administrative policies.
_____ c. Demonstrates use of good judgment by obtaining and analyzing facts and applying them to situations to reach logical decisions in technical and non-technical situations.
_____ d. Makes decisions in complex as well as routine situations as necessary.
_____ e. Utilizes results obtained in quality control procedures as a basis for decisions in reporting results.
_____ f. Voluntarily repeats tests giving illogical results without being asked to do so by the supervisor.
_____ g. In repeating tests, "trouble shoots" by checking reagents and introducing variables that may determine the source of a problem.

4. Initiative
_____ a. Looks for things to do and does them without being asked. This includes technical work: duties necessary to maintain a clean, orderly work area; etc.
_____ b. Voluntarily assists co-workers with work.
_____ c. Voluntarily does and reports additional laboratory work (even though it may not be requested) to prove or enhance laboratory findings when circumstances warrant.
_____ d. Readily undertakes any procedure requested in his area of responsibility with little or no instruction from supervisor.
_____ e. Reads publications pertaining to work. (Evident by conversation about publications and/or interest in introducing newly reported methods or modifications or existing methods, hints on improving techniques, etc.)
_____ f. Readily supports and puts into practice changes made in procedures (technical and/or administrative) in the interest of accuracy, precision and/or efficiency.
_____ g. Is a member of appropriate professional organization.
_____ h. Shows desire to continue education by having attended local, regional and/or national educational meetings within the past 18 months.
_____ i. Attends educational programs offered within the institution as work schedule and opportunity allow. (Such as in-service training sessions; Pathology Conferences; Medical, Surgical and Grand Rounds; guest lecturers, etc.)
_____ j. Reports, formally or informally, on attendance at educational meetings for the benefit of other members of the staff.
_____ k. Constructively suggests modifications of administrative policies if occasion arises.
_____ l. Willingly accepts responsibility to participate in teaching students (if there is a teaching program).

5. Personal Relations
_____ a. Well-liked by co-workers.
_____ b. Respected by co-workers for good use of professional ability and judgment, exemplary personal conduct, and good patient relations.
_____ c. Respected by supervisors for good use of professional ability and judgment, exemplary personal conduct and good patient relations.
_____ d. Respected by other members of the staff within the institution and the medical staff for good use of professional ability and judgment, exemplary personal conduct and good patient relations.

Rating

_____ e. Readily accepts instruction and constructive criticism from supervisors.
_____ f. Is considerate of patients. (That is: shows interest, appears to be unhurried, is efficient, gives explicit instructions, smiles, and has well-controlled voice.)
_____ g. Shows interest in and respect for co-workers.
_____ h. Shows interest in and respect for laboratory assistants and readily helps them with technical problems.
_____ i. Shows respect for non-technical workers in the laboratory and institution.
_____ j. Shows respect for other paramedical personnel in the institution, (such as Xray technologist, nurse, physical therapist, etc.)
_____ k. Personal appearance is exemplary: Clean uniform and shoes, personally neat.

6. Would you promote this person to a higher position if you had the opportunity?
Yes _____ No _____

If your answer is no, does this mean that you think this person is displaying his maximum capability and has reached his maximum work potential?
Yes _____ No _____

If your answer is still no, what are your reasons for not wanting to promote this person?

7. If there are other factors you consider in your evaluation of personnel, please list them below and comment.

8. In order that we might know the scope of work done in your laboratory would you please send us a copy of your annual report of procedures (determinations or tests) done in your laboratory.

3-26-65

NATIONAL COUNCIL ON MEDICAL TECHNOLOGY EDUCATION
1025 E. H. Crump Boulevard
Memphis, Tennessee 38104

MEDICAL TECHNOLOGY EDUCATION STUDY
Phase I

Supervisor's Form B

(Note: You do not need to be concerned about the columns on the left side of each page "IBM, Col., Item". They will be used later for analysis of the data.)1/

Supervisor of Registrant #__________ Supervisor Study # __________

1. Name: ______________________________
(Last) (Middle) (First)

2. Regisry Number: ASCP _______________
Other _______________ by ____________________
(organization)

3. Age: ________

4. Total number of years of experience in medical technology ________

5. Present place of employment: ______________________________
____
Address: ______________________________
(Street)
____
(City) (State) (Zip Code)

6. Title of position at present ____________________
If supervisor of a laboratory department, please state which department.
____

7. Number of years in present position: ________

8. Number of people you supervise in your laboratory:
Technical: ______
Clerical: ______
Maintenance: ______

9. Education:
a. Have you had formal education and/or training in medical technology?
____ Yes ____ No

10. Give names and addresses of colleges or universities and/or schools attended and year graduated: ______________________________
____
____

1/ Columns on the left for IBM analysis are deleted in this reproduction of the questionnaire

College--University

1) How many years did you attend the college or university and/or schools attended?

1. _____ 1 year
2. _____ 2 years
3. _____ 3 years
4. _____ 4 years
5. _____ 5 years
6. _____ 6 years
7. _____ More than 6 years

School of Medical Technology or the like.

1. _____ 1 year
2. _____ 2 years
3. _____ 3 years
4. _____ More than 3 years

2) What degree did you receive and in what major field did you receive it?

1. _____ None
2. _____ Associate of Arts in ____________________
3. _____ Bachelor of Arts in ____________________
4. _____ Bachelor of Science in ____________________
5. _____ Master of Science in ____________________
6. _____ Master of Arts in ____________________
7. _____ Doctor of Medicine
8. _____ Doctor of Philosophy in ____________________
9. _____ Other: ____________________

____

3) Aside from formal education and/or training in medical technology, where have you worked, and, in general, what kind of work have you done? Please give the years you worked in each place. ____________________

____

____

10. Professional Organizations:

a. To what professional organizations do you belong?

1. _____ American Association for the Advancement of Science
2. _____ American Association of Bioanalysits
3. _____ American Association of Blood Banks
4. _____ American Association of Clinical Chemists
5. _____ American Society of Medical Technologists
6. _____ American Society of Clinical Pathologists
7. _____ American Society of Microbiologists
8. _____ American Medical Technologists
9. _____ College of American Pathologists
0. _____ International Society of Clinical Laboratory Technologists
X. _____ Other: (Please list) ____________________

____

____

____

b. What continuing education programs have you attended in the past 18 months? Please give the month and year.

1) _____ Graduate Schools (List Courses)

____

____

2) _____ Postgraduate courses in medical technology
   1. _____ University of Colorado
   2. _____ University of Kansas
   3. _____ University of Minnesota
   4. _____ Other: (Please list) ______________________

____

____

3) _____ Seminars of Joint Commission on Continuing Education in Medical Technology. (Please list) ______________________

____

____

4) _____ National, regional and/or local organization meetings.
   1. _____ American Association for the Advancement of Science
   2. _____ American Association of Bioanalysts
   3. _____ American Association of Blood Banks
   4. _____ American Association of Clinical Chemists
   5. _____ American Society of Medical Technologists
   6. _____ American Society of Clinical Pathologists
   7. _____ American Society of Microbiologists
   8. _____ American Medical Technologists
   9. _____ College of American Pathologists
   0. _____ International Society of Clinical Laboratory Technologists
   X. _____ Other: (Please list) ______________________

____

____

5) _____ Other (Please list) ______________________

____

____

____

11. Of the following scientific journals and periodicals which have you read in the past 6 months? If there are others not listed, please indicate them under "Other" if you read them regularly.
    1. _____ American Journal of Clinical Pathology
    2. _____ American Journal of Medical Technology
    3. _____ Blood
    4. _____ Clinical Chemistry
    5. _____ Journal of Bacteriology
    6. _____ Journal of the American Medical Association
    7. _____ Lab World
    8. _____ Technical Bulletin of the Registry of Medical Technologists
    9. _____ The Lancet
    0. _____ Transfusion
    X. _____ Other ____

____

____

____

12. Please list scientific books related to your work that you have used frequently in the past 6 months.

____

____

____

____

____

____

Thank you for your assistance

3-26-65

NATIONAL COUNCIL ON
Medical Technology Education
1025 E. H. Crump Boulevard, Memphis, Tenn. 38104
area 901 *phone 526-6581*

research associate: RUTH I. HEINEMANN, MT (ASCP) *education associate:* ARCH LUGENBEEL
council members: REX D. COUCH, M.D., CHAIRMAN; NELLIE MAY BERING, MT (ASCP); JOSEPH A. CUNNINGHAM, M.D.; MARY FRANCES JAMES, MT (ASCP). TYRA T. HUTCHENS, M.D.; AND ROBERT W. COON, M.D., EX OFFICIO

(Personally addressed to supervisor. Accompanied by "Supervisor's Form A and B")

In October 1964, the National Council on Medical Technology Education was established by the National Committee for Careers in Medical Technology through funds provided by the Cancer Control Program of the U. S. Public Health Service. General Information about the Council is enclosed. You will note that the initial activities of the Council are to study, in depth, various aspects of medical technology education.

The first study activity is devoted to determining whether or not there is correlation between an individual's education and his performance on the job. We have selected a random sample of people who took the ASCP Registry examination in medical technology in July 1962. To each person selected we have sent a questionnaire seeking information about his place of employment and the kind of work he is doing. Each is asked to give permission to obtain information from his supervisor. To each supervisor named we are sending a request for information about the person selected.

Your name was given by as his immediate supervisor. We would appreciate your giving your time to complete the enclosed forms from your experience as his supervisor. It will be helpful if you will do this and return the completed forms in the enclosed envelope as soon as possible. Your replies will be kept in confidence.

Medical Technologists and pathologists are giving much time and effort to the development of education in medical technology. The establishment of the National Council on Medical Technology Education provides an opportunity to clarify these efforts. By completing and returning the forms promptly you will contribute to the efforts of the Council in the furtherance of medical technology education. Thank you for your interest in participating in this study.

Sincerely,

Ruth I. Heinemann, M.T.(ASCP)
Program Coordinator

RIH/nr
Encl.

NATIONAL COUNCIL ON
Medical Technology Education
1025 E. H. Crump Boulevard, Memphis, Tenn. 38104
area 901 *phone 526-6581*

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(Follow-up letter to supervisor to solicit return of questionnaires.)

A few weeks ago you should have received a letter and forms from the office of the National Council on Medical Technology Education asking you to assist in a study.

Your name was given as supervisor of one of the 447 people from the group taking the July 1962 Registry examination which has been selected for the study. To date we have received replies from 270 of these examinees and sent forms to their supervisors where indicated. The information from the supervisors is necessary in order that we can complete the study.

Since we have not heard from you, this is to remind you to return the forms with appropriate replies. If, for some reason, you have not received the letter and forms, please let us know, so that we may send them to you.

We will appreciate hearing from you within the next two weeks.

Sincerely,

Ruth I. Heinemann, M.T.(ASCP)
Program Coordinator

RIH/nr

NATIONAL COUNCIL ON
Medical Technology Education
1025 E. H. Crump Boulevard, Memphis, Tenn. 38104
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(Second follow-up letter to supervisors to solicit return of questionnaires.)

In the past 6 weeks you should have received letters and forms from the office of the National Council on Medical Technology Education asking you to assist in a study.

Your name was given as supervisor of one of the 447 people from the group taking the July 1962 Registry examination which has been selected for the study. To date we have received replies from 270 of these examinees and sent forms to their supervisors where indicated. Two weeks ago we sent you a letter reminding you to return the forms with appropriate replies.

We urge you to complete the forms and return them as soon as possible. If, for some reason, you have not received or have misplaced the letter and forms, please let us know, so that we may send you another set.

Your assistance by completing these forms is invaluable in the progress of our study. We will appreciate hearing from you as soon as possible.

Sincerely,

Ruth I. Heinemann, M.T.(ASCP)
Program Coordinator

RIH/nr

BIBLIOGRAPHY OF RELATED STUDIES

Sister Charles Adele: Responsibilities deepen for technologists. Hospital Progress 39:111 (November) 1958
In blood banking, medical technologists have a responsibility both to the parent and to his descendents. There is a great need for continuing education in new methods of selection and crossmatching of blood. A five-day workshop in Chicago pointed out one way of accomplishing this.

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Colleges should offer a broad background in liberal arts. Science courses should emphasize theory and the principles behind procedures, as well as techniques. Counselling should be available both before and during college years. The approach of the School of Allied Health Professions of the University of Pennsylvania is presented in detail.

Chable, M. R.: Etude comparative de la formation des aides-techniques de laboratoire medical. Veska 4:393 (1963)

Clute, K. F.: The general practitioner: a study of medical education and practice in Ontario and Nova Scotia. University of Toronto Press. 1963

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Gilstrap, M. A.: Medical technology training: a follow-up study of graduates. The American Journal of Medical Technology 27:101 (March-April) 1961
Recent medical technology graduates of the University of Washington were questioned about their training and its value to them in their work. They were generally satisfied particularly with the theoretical aspects of their training. They expressed a need for more practical experience and for certain specific instructions. In assessing the special teaching devices used in the training program, they rated highly the use of notebooks, laboratory demonstrations and student laboratory but felt poor oral presentations had reduced the value of student seminars. While they wanted more professional recognition, they were not particularly active in the American Society of Medical Technologists.

Gross, J. D.: Characteristics of an effective laboratory. Hospital Progress 47:42 (March) 1966
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Leuenberger, V.E.: Die laborantin im spitalbetrieb. Veska 4:321, 1963

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Parrish, J.B.: Employment of women chemists in industrial laboratories. Science 148:657 (April) 1965
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This is a presentation of the development, results and subsequent recommendations of a survey of existing personnel, facilities and technical practices in the medical laboratories of 145 licensed general hospitals in Minnesota.

NATIONAL COUNCIL ON MEDICAL TECHNOLOGY EDUCATION

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Advisory Committee

The Advisory Committee is composed of one representative from each of the following organizations:

Board of Registry of Medical Technologists of the American Society of Clinical Pathologists
Board of Schools of Medical Technology of the American Society of Clinical Pathologists
Board of Certified Laboratory Assistants of the American Society of Clinical Pathologists
Education Committee of the American Society of Medical Technologists
ASMT-ASCP Joint Commission on Continuing Education in Medical Technology
Board of Trustees, ASMT Education & Research Fund, Inc.

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